Vagal flexibility and parenting behaviors in post-deployed military fathers

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Most progress of this dissertation were made during a period of time following my grandma's funeral. Having to visit my home country for the loss of a family member was difficult. After I returned from the visit, I shifted my attention to this dissertation and worked relentlessly to cope with my grief. On October 22nd, at 1:30AM, this project came to a breakthrough. I had tears in my eyes and went to wake up my asleep husband with my discovery.

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ABSTRACT

The lives of about two million American children have been affected by the military deployment of a parent. A parent's deployment influences children's adjustment through compromised parenting. While an emerging body of literature suggests that effective parenting requires parental emotion regulation, few studies have focused on fathers. In addition, limited knowledge exists about whether or how fathers' emotion regulation might affect their responsivity to a parent training program. With a focus on military fathers who had been deployed since 2001, the current research consisted of two studies that investigated vagal flexibility as an index of physiological emotion regulation and social engagement in relation to observed parenting behaviors. The first study, entitled "Military fathers' nurturing parenting: Psychological and physiological flexibility both matter", demonstrated that vagal flexibility buffers against the negative effects of psychological inflexibility (i.e. self-reported experiential avoidance) on observed emotion-related parenting. The second study, entitled "Adapting to 'ADAPT': Vagal flexibility predicts military fathers' changes in parenting following a parent training program", tested the effect of vagal flexibility in predicting the degree of changes in observed parenting skills at 1-year follow-up in a randomized controlled trial of the After Deployment Adaptive Parenting Tools/ADAPT program. These two studies provided evidence for the role of cardiac vagal tone as a correlate of emotion-related parenting and a tailoring variable to inform precision-based parenting programming for military fathers.

Key words: Cardiac vagal tone; emotion regulation; parenting; prevention.

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OVERVIEW

Since 2001, there have been prolonged and repeated deployments of large numbers of US military personnel to Afghanistan and Iraq. In 2014, the total number of U.S. military personnel was over 3.5 million. Deployments place significant and unique stressors on the lives of service members and their family members. Deployed service members may exhibit elevated risk of mental health problems such as PTSD symptoms (Milliken, Auchterlonie, & Hoge, 2007), which are associated with emotion dysregulation. Parents with poorer emotion regulation capacities may be less able to successfully apply behavioral parenting skills consistently when facing additional stress from challenging parent-child interactions, compared with their counterparts with better emotion capacities (Crandall, Deater-Deckard, & Riley, 2015; Snyder et al., 2013).

The After Deployment Adaptive Parenting Tools (ADAPT) program, designed to buffer parenting in families who have experienced deployments, has shown positive effects in reducing parent mental health problems, enhancing parenting practices, and decreasing child maladjustment behaviors (Gewirtz, DeGarmo, & Zamir, 2016, 2017a; Piehler, Ausherbauer, Gewirtz, & Gliske, 2016). However, few studies have tested the relationship between emotion regulation and parenting in military fathers, and little is known about whether emotion regulation can indicate what subgroups of fathers may benefit more from the ADAPT program, or less, than others.

In the current research, vagal flexibility denotes dynamic physiological regulation of cardiac vagal tone and reflects a unique aspect of emotion regulation “below the skin”. Positive effective parenting behaviors may at least in part be supported by vagal flexibility given its role in emotion regulation, psychological flexibility, and social engagement behaviors (Porges, 2007). The current research tests hypotheses regarding the link between vagal flexibility and parenting in two studies: Study 1 focuses on the effects of an interaction between vagal flexibility and self-reported psychological flexibility (i.e., experiential avoidance) on observed emotion-related parenting. Study 2 evaluates whether vagal flexibility predicts military fathers' responsivity to the ADAPT program with respect to changes in parenting at 1-year follow-up.

There are three theoretical frameworks guiding the current research: 1) Polyvagal theory, which posits that cardiac vagal tone affects emotion regulation, psychological flexibility, and social engagement behaviors; 2) A conceptual model linking parental emotion regulation/cognitive control to parenting, and 3) Social Interaction Learning (SIL) theory, which is the fundamental conceptual framework underlying the ADAPT program. These theoretical frameworks are briefly reviewed. Subsequently, the two studies are presented. Finally, a comprehensive discussion synthesizes the implications of the current research.

CONCEPTUAL FRAMEWORKS

Polyvagal Theory

With a focus on the parasympathetic branch of the autonomic nervous system, Porges (2011) developed polyvagal theory that has informed research on the physiological process of emotion regulation. Emotions are whole-body phenomena, which means that emotion regulation includes physiological processes (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005). The expression and regulation of emotions in part depend on the homeostasis of the body. The reason for this is that our affect (i.e., simple feelings like pleasant or unpleasant) comes from an ongoing process – *interoception*, which refers to the sense of the physiological condition of the body. Interoception is associated with the autonomous nervous system, which consists of the parasympathetic and sympathetic nervous systems (PNS and ANS, respectively)[1]. In short, the PNS as part of the autonomic nervous system has an important role in controlling the homeostasis of the body which contributes to interoception. From this standpoint, emotion regulation can be indexed by the functioning of the PNS. Since the development of polyvagal theory, a number of empirical studies (e.g., Butler, Wilhelm, & Gross, 2006) have provided data supporting the linkage between emotion regulation and PNS functioning in terms of vagal control over the heart, i.e., cardiac vagal tone.

The vagus nerve, or the 10th cranial nerve, is the major parasympathetic tract, containing about 75% of the fibers of the PNS. Its neural pathways originate in the

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[1] The PNS and ANS both have influences on our physiology; in general, the PNS promotes growth, rest and restorative functions whereas the SNS promotes increased metabolism and arousal to help coping with stressful stimuli from the environment.

brainstem and connect to just about every major organ in the body, such as the heart, lung, stomach, and intestines (Muhtadie, Koslov, Akinola, & Mendes, 2015). It undergirds unique physiological mechanisms for stress-coping. According to polyvagal theory, the more ancient vagus (evolved from reptiles) supports a "freeze" defensive response to a detected threat. On the other hand, the newer myelinated mammalian vagus is associated with social communication and engagement behaviors, if safety is detected. This hierarchy of the autonomic nervous system resulted from phylogenesis. Other than the vagal system, also in this hierarchy is the SNS, which supports "fight or flight" defensive responses to a detected threat. Studies on the impacts of SNS and the hypothalamic-pituitary-adrenal axis on stress-coping have proliferated since the late 1960s, whereas a small but growing body of literature on the vagal system has just recently emerged.

Polyvagal theory suggested the linkage between the vagus nerve and self-regulation, social engagement, and flexible/adaptive behaviors required by a changing environment (Porges, 2011). What is unique about the vagus nerve is that not only it connects to organs like the heart, but over the process of evolution, it also has integrated with the nuclei that regulate the muscles of the face, neck and head, which critically support social communication processes. A possible way to measure the functioning of the vagal system is through rapid changes in heart rate, because the vagus nerve connects to the heart[2]. It serves as a "brake" to slow heart rate (Porges, 2003, 2007). Heart rate,

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[2] The heart is displaced to the left side of the body, and the right vagus is going to its sinoatrial (SA) node and the left vagus going to the atrioventricular (AV) node. Sympathetic and parasympathetic nervous systems both exert control over the SA node through innervations; however, parasympathetic effects are faster (by neurotransmitter acetylcholine) which are present at high frequency, whereas sympathetic effects

when examined alone, is influenced by the autonomic nervous system (including both PNS and SNS), the neuroendocrine system, and other factors. However, researchers have regarded respiratory sinus arrhythmia (RSA) as a reliable and valid measure of cardiac vagal tone. RSA is defined as heart rate *variability* in the frequency band of human respiration (typically between 0.15 ~ 0.4Hz in adults). As such, it represents the patterns of activation and flexibility of the parasympathetic vagal “brake”.

Parental Emotion Regulation and Parenting

Crandall, Deater-Deckard, & Riley (2015) described a model to illustrate the pathways from emotion regulation and cognitive control to parenting. The authors proposed that emotion regulation and cognitive control have direct influences on both positive parenting and negative, which in turn impacts each stage of child development. Notwithstanding the importance of emotion regulation, few studies have investigated the impact of parental emotion regulation on parenting, while more studies investigated parental executive function, such as inhibitory control (Deater-Deckard, Wang, Chen, & Bell, 2012), working memory (Deater-Deckard, Sewell, Petrill, & Thompson, 2010), and other related concepts.

This review mostly included studies with mother samples, although the authors suggested that the relationship between paternal emotion regulation and parenting may be similarly applied to fathers. Indeed, evidence linking emotion regulation to fathers’ parenting is sparse.

Social Interaction Learning Theory

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are slower (by neurotransmitter norepinephrine), which are not present at high frequency. Sympathetic respiratory rhythms are effectively filtered out at SA node.

The ADAPT program was a modification for military families of the Parent Management Training- Oregon Model (PMTO). PMTO was developed based on Social Interaction Learning (SIL), an empirically tested theoretical model (Forgatch & Patterson, 2010). The model emphasizes that context influences social environments, and social environments shape social interaction patterns by reinforcing contingencies which in turn affects children's adjustment. Parental influences are proximal to a child. Parents can create a positive family environment by using effective discipline, monitoring, positive involvement, skill encouragement, and problem solving. On the other hand, parents can create a coercive family environment by using negative reciprocity, escalation, and negative reinforcement. An outer layer besides parental influences consists of stressful contexts including culture, family structure, socioeconomic factors, social support, and parents' marital adjustment. These backgrounds are more distal and may influence children's adjustment through their influences on the quality of parenting. SIL presents a developmental, sequential-state model for the progression of antisocial behavior from childhood to adolescence. At first, coercive family processes lead to increased child antisocial and externalizing behaviors. Subsequently, antisocial children opt into deviant peer relationships during middle childhood and early adolescence. At this stage, increased deviant peer relationships and continued deviant behaviors contribute to further development of more serious forms of antisocial behaviors such as violence and criminal offense (Patterson, Forgatch, & Degarmo, 2010). Thus, PMTO considers parents as the agents of change, and teaches parents the necessary skills to increase positive parenting practices and decrease coercive parenting.

MANUSCRIPT ONE

Military fathers' nurturing parenting:

Psychological and physiological flexibility both matter

Synopsis

This study sought to test the roles of parental vagal flexibility and experiential avoidance in observed emotion-related parenting among post-deployed military fathers. Vagal flexibility is a physiological index of emotion regulation and social engagement behaviors, whereas experiential avoidance reflects psychological inflexibility or emotion dysregulation (i.e., avoiding one's negative feelings and thoughts). The study analyzed data from 92 male military service members who had been deployed to Iraq and/or Afghanistan since 2001. They were mostly White (88%), in their 30s (M age = 37.37, SD = 6.42), middle-class, and married (92.3%). All fathers participated in home-based assessments with their spouses (if married) and a target child aged between 4-13 years. Emotion-related parenting behaviors were observed during a set of family interaction tasks and quantified into four categories using a macro-level coding system: positive engagement, withdrawal avoidance, reactivity coercion, and distress avoidance. Fathers' vagal flexibility was measured as the change in cardiac vagal tone from a neutral reading task to a father-child conflict resolution task. Experiential avoidance was self-reported. Results of multiple regression showed no significant main effects of vagal flexibility on any observed parenting measures. Significant moderation effects of experiential avoidance by vagal flexibility were found, showing that among fathers with poorer vagal flexibility, a stronger relationship was evident between experiential avoidance and observed emotion-related parenting behaviors (positive engagement and withdrawal avoidance), whereas among fathers with higher vagal flexibility, no such relationship was shown. The moderation effect was not found for observed reactivity coercion or distress

avoidance. These findings have important implications for the linkage between emotion regulation and parenting in military fathers.

In 2014, the total number of U.S. military personnel was over 3.5 million (U.S. Department of Defense, 2015). Since 2001, Operations Enduring, Iraqi Freedom (OEF/OIF), and New Dawn, have resulted in prolonged and repeated deployments of large numbers of military personnel to Afghanistan and/or Iraq. While most service members who return from war are resilient and do not exhibit psychopathology (Bonanno et al., 2012), the literature has documented the elevated risk of mental health problems in this population. For example, Hoge, Auchterlonie, and Milliken (2006) showed that Army soldiers and Marines reported posttraumatic stress disorder (PTSD), depression, alcohol misuse, suicidal ideation, and interpersonal conflicts after returning from Afghanistan or Iraq. Longitudinal studies have reported increased PTSD symptoms among deployed service members from pre- to post-deployment, and relative to non-deployed service members (Vasterling et al., 2010). Further, deployed service members reported more mental health concerns and significantly higher rates of clinical referral at 6-month follow-up compared with their initial post-deployment assessment (Milliken et al., 2007). Over one-third of a sample of American service members who returned from Iraq or Afghanistan indicated a possible problem with substance use and about 43% reported feelings of depression during the previous month (Baker et al., 2009). Finally, a meta-analysis concluded that PTSD prevalence among OEF/OIF veterans was about 23% (Fulton et al., 2015).

The risks of mental health problems in post-deployed service members are particularly worrying because many of these individuals (about 42% of the total military personnel) are parents (U.S. Department of Defense 2015). Studies of children with deployed parents showed that parental depression or PTSD symptoms were associated with poor social-emotional adjustment of children including anxiety problems (Lambert, Holzer, & Hasbun, 2014; Lester et al., 2016). Gewirtz, DeGarmo, & Zamir (2017b) proposed a military family stress model and empirically demonstrated that the association between maternal PTSD symptoms and child behavioral problems was mediated through parenting practices, while paternal PTSD symptoms were directly associated with child behavioral problems.

Fathers' parenting has been associated with child outcomes in the civilian family context (Adamsons & Johnson, 2013; Lee & Schoppe-Sullivan, 2017; Sarkadi, Kristiansson, Oberklaid, & Bremberg, 2008). However, less scholarly attention has been paid to fathers' parenting compared with mothers' parenting. Research on post-deployed fathers' parenting is particularly important for at least two reasons: first, fathers' effective parenting is a sign of successful post-deployment integration in the family; second, effective parenting contributes to a healthy father-child relationship, which is a protective factor especially for those with mental health problems.

Emotion regulation and parenting in the context of deployment

Parenting is determined by environmental, psychological and neurobiological factors (Belsky & Jaffee, 2015). Emotion regulation is one of the factors. For example, parents who find their own negative feelings/thoughts painful or uncontrollable may tend to dismiss, ignore, or minimize their children's negative feelings/thoughts (Gottman et al., 1996). They may also engage in intrusive, coercive parenting to reduce children's distress as a way to reduce their own distress reminders (Tiwari et al., 2008). Such parenting practices can be termed nonsupportive parental emotion socialization, which was found to be associated with child conduct problems (for a review, see Johnson, Hawes, Eisenberg, Kohlhoff, & Dudeney, 2017). Emotion regulation is defined as one's ability to modulate the intensity and/or duration of emotions (Gross, 1988). It is intertwined with cognitive control processes including attentional control or cognitive changes (Ochsner & Gross, 2005). Crandall, Deater-Deckard, & Riley (2015) suggested that parental emotion regulation and cognitive control are important for parents under stress to respond flexibly instead of being over-reactive with their children. However, most empirical support for this hypothesis was drawn from research in mothers, with only a few studies included fathers (e.g., Hughes & Gullone, 2010). More studies with a focus on fathers are necessary to fully test the hypothesis that parental emotion regulation is influential to parenting.

Experiential avoidance is an underlying process of maladaptive emotion regulation strategies and an indicator of psychological inflexibility (Wolgast, Lundh, & Viborg, 2013). It is defined as the attempt to escape or avoid private events (e.g., unwanted feelings or thoughts) even when the attempt to do so causes psychological harm (Hayes & Wilson, 1994). Due to an inability to have control over situations, humans tend to avoid painful thoughts and feelings even though they might be unrelated to traumatic experiences and normally thought to be harmless (Hayes, 2016). While experiential avoidance is common in all humans, research has indicated its relationship with psychopathology including substance abuse, anxiety, depression, and PTSD (for a review, see Neharika Chawla & Ostafin, 2007).

Experiential avoidance may be particularly relevant to military service members who were exposed to combat trauma. For instance, experiential avoidance was found to predict increased or maintained PTSD symptoms over time in a post-deployed sample (Snyder et al., 2016). Indeed, avoiding negative feelings and thoughts paradoxically reinforces PTSD symptoms because those feelings and thoughts gradually acquire fear-inducing capacities through higher order conditioning and stimulus generalization (Cahill & Foa, 2007). Experiential avoidance also influences service members' interpersonal relationships. For example, Reddy, Meis, Erbes, Polusny, and Compton (2011) found that veterans' experiential avoidance was associated with decreases in couple relationship adjustment and increases in aggression towards their spouses. Zamir, Gewirtz, Labella, DeGarmo, and Snyder (2017) found that not only did military service members' experiential avoidance predict their own marital satisfaction, but it also predicted their female spouses' marital satisfaction. Finally, experiential avoidance may mediate the impact of PTSD symptoms on parenting behaviors. Brockman et al. (2016) found that experiential avoidance was associated with observed parenting during family interactions above and beyond combat trauma exposure, PTSD symptoms, and child aversive behaviors (as child behaviors may influence fathers' parenting).

Cardiac vagal tone, emotion regulation, and parenting

Emotion regulation involves physiological processes in addition to coping with one's experiential feelings (Mauss et al., 2005). An examination into psychophysiology may help to better understand military fathers' parenting processes. A full description of the physiological processes of emotion regulation is beyond the scope of this paper.

Briefly speaking, our affect is closely related to interoception - the sense of the physiological condition of the body – including a fast heart rate, short and shallow breathing, or indigestion (Barrett, 2017). And the parasympathetic and sympathetic branches (PNS and ANS, respectively)[3] of the autonomous nervous system exert critical influences on the homeostasis condition of the body. Polyvagal theory (Porges, 2011) highlights the role of the PNS, suggesting that our human mammalian parasympathetic vagal system undergirds unique mechanisms for emotion regulation. In particular, the myelinated mammalian vagus supports social engagement behaviors by regulating our physiological arousal.

As such, one of the vagus nerve functions is to work as a "brake" to slow heart rate[4], which enables a measure of vagal tone via heart rate variability (HRV), i.e., cardiac vagal tone. Researchers have regarded the high frequency component of HRV (HF-HRV) as a reliable and valid measure of cardiac vagal tone. In the literature, it is also labeled as respiratory sinus arrhythmia (RSA). *Baseline* RSA ("tonic RSA," "resting RSA") reflects one's general levels of parasympathetic functioning or emotion reactivity. Exiting evidence suggests its adaptability (Thayer, Ahs, Fredrikson, Sollers, & Wager, 2012), and yet some data have shown that a rigid maintenance of high baseline RSA may be maladaptive in some circumstances (Pu, Schmeichel, & Demaree, 2010). A meta-analysis

[3] The PNS and ANS both have influences on our physiology; in general, the PNS promotes growth, rest and restorative functions whereas the SNS promotes increased metabolism and arousal to help in coping with stressful stimuli from the environment.

[4] The heart is displaced to the left side of the body, with the right vagus going to its sinoatrial (SA) node and the left vagus going to the atrioventricular (AV) node. Sympathetic and parasympathetic nervous systems both exert control over the SA node through innervations; however, parasympathetic effects are faster (due to neurotransmitter acetylcholine) and the effects are present in high frequency. Sympathetic effects are slower (due to neurotransmitter norepinephrine) and the effects are not present in high frequency. Sympathetic respiratory rhythms are effectively filtered out at the SA node.

showed a small-to-medium relationship between baseline RSA and depression (Rottenberg, 2007), indicating that baseline RSA may not be a strong predictor of emotion regulation, given the close relationship between depression and emotion regulation.

On the other hand, *vagal flexibility* ("phasic HRV," "vagal withdrawal," "vagal reactivity," "vagal suppression," or "vagal regulation") refers to one's cardiac vagal tone *changes* between two different time points, typically from baseline to coping with an environmental challenge. It represents one's ability to release the vagal "brake," accelerate the heart rate, and increase metabolism, as ways to engage in a stressful environment without compromising control. Rapid changes of cardiac vagal tone may facilitate emotional processes and allow the body to optimally cope with social challenges (Porges, 2011). Thus, vagal flexibility is considered a marker of adaptability or effective emotion regulation (e.g., Butler et al., 2006). Muhtadie et al. (2015) showed that individuals with higher vagal flexibility perceived social-emotional information more accurately and exhibited greater sensitivity to their social context compared with those with lower vagal flexibility. This finding informs the consideration of parental vagal flexibility in parenting research, as social sensitivity to emotional information is crucial to parenting.

Researchers have begun to investigate the association between parental vagal flexibility or baseline RSA and parenting. For example, Perlman et al. (2008) reported a positive relationship between maternal baseline RSA and supportive responses to children's emotions. Connell et al. (2017) showed that greater changes in cardiac vagal tone was associated with less expression of parental anger during parent-child interactions in a predominantly mother sample. In one study that included equal numbers of fathers and mothers, Blandon (2015) showed that high levels of baseline RSA were associated with high levels of supportive emotion socialization in fathers. In addition, researchers have found moderating effects of cardiac vagal tone. For instance, Root, Hastings, and Rubin (2016) found that maternal baseline RSA moderated the relationship between maternal shyness-anxiety and overprotective parenting. Similarly, highly stressed mothers (indicated by high salivary cortisol levels) exhibited more negative intrusiveness with their children if they also exhibited low (vs. high) vagal flexibility (Mills-Koonce et al., 2009). To date, no studies have examined the role of vagal flexibility in observed parenting behaviors among fathers who were exposed to war deployment.

Vagal flexibility was selected for research in the current study because: 1) whether high baseline RSA is adaptive or maladaptive is still debatable, as discussed above; 2) in our data, an approximation of baseline RSA was measured during a reading task instead of a resting task. Reading involves speaking and listening, serving as a control condition.

The current study

The current study sought to test whether parental vagal flexibility was associated with observed parenting in post-deployed military fathers, and whether parental vagal flexibility moderated the relationship between experiential avoidance and observed emotion-related parenting behaviors. Building on previous work showing the linkage between emotion regulation and parenting (Brockman et al., 2016; Crandall et al., 2015) , as well as the moderating role of cardiac vagal tone (Mills-Koonce et al., 2009; Root et al., 2016), the current study tested two hypotheses: 1) vagal flexibility would be associated with observed emotion-related parenting in fathers; 2) vagal flexibility would moderate the association between experiential avoidance and observed emotion-related parenting in fathers, such that fathers with poorer experiential avoidance would exhibit poorer emotion-related parenting behaviors if their vagal flexibility was lower. In accounting for observed emotion-related parenting behaviors during parent-child interactions, we controlled child behavior problems due to possible mutual influences between father and child behavior patterns (Brockman et al., 2016).

Method

Sample

The sample included fathers and their family members who participated in an intervention study designed for military families with a deployed parent (Gewirtz et al., 2017a). The original sample consisted of 282 post-deployed fathers, but the current study used a subsample, excluding fathers without HRV data or observed emotion-related parenting data. Specifically, 127 fathers did not have HRV data due to the following reasons: a reading task was not administered (n = 54); fathers refused to wear equipment or did not participate (n = 3); physiological data was irretrievable due to administrative errors or equipment malfunctions (n = 39); times of family interaction tasks were unavailable due to video-recording problems (n = 19); heart rate data had excessive artifacts (n = 11); and fathers used medication that affects vagal tone (n = 1). In addition, fathers were excluded if family interaction tasks were conducted in a classroom setting (vs. family homes) (n = 8)[5] or constantly interrupted by a second child other than the target child (n = 1). Among the remaining fathers, 54 fathers whose observations not coded on emotion-related parenting were excluded. This yielded a final sample of 92 fathers.

Independent-sample t-tests and chi-square tests were performed to compare if there were key demographic differences between deployed fathers who were included in this study and those who were not. Results showed no significant differences in fathers' age, race, marital status, education, annual household income, number of children at home, target child age/sex, and cumulative length/ times of deployment.

Fathers were 37.37 years old on average (SD: 6.42; Range: 24 – 58) and most of them (88%) were White. Their socioeconomic profiles indicated middle-class status: a little over half (57.8%) reported annual household income above $70,000 and about one-third (34.4%) reported between $40,000 – $69,999. Over half (55%) of the fathers completed a 4-year college degree or above and 37.4% attended some college or received an Associate's degree. Most fathers were married or partnered (92.3%) and these fathers reported length of marriage with their current partner as 9.54 years on average (SD = 5.17; Range: 1 – 23). Most fathers were deployed between 1 to 3 times (33.7%, 40.2%, 17.4%, for deployed once, twice, and three times, respectively). Almost one-third (29.3%) of the sample reported cumulative length of deployment as less than 12 months,

[5] Family interaction took place in a classroom setting is, to some degree, similar to a laboratory experiment, whereas family interaction took place at home resembles a naturalistic environment. Gardner (2000) reviewed the literature on parent-child interactions and concluded that interactions in artificial settings are not necessarily representative of those taking place at home.

a little over one-third (33.7%) reported 13-24 months, 29.4% reported 25-36 months, and 7.6% reported more than 37 months of deployment. About one-third (29.7%) of the fathers returned home from their most recent deployment within 1 year, over half (57.1%) were between 1-5 years, and 13.2% were between 6-9 years. The average number of children living at home was 2.40 (SD: 0.85; Range: 1 – 4). About half of the families (55.4%) had a boy (vs. a girl) as the target child in the study. Their children were aged 8.86 years on average (SD = 2.71; Range: 4.15 – 13.32).

Procedure

Recruitment. Families were eligible to participate in the larger research project if at least one parent had been deployed to Afghanistan and/or Iraq since 2001, and at least one child was 4-12 years old. Participants were recruited using multiple strategies including presentations at events for NG/R families, targeted mailings from the local Veterans Affairs Medical Center, social media (e.g., Facebook), flyers or prints, and word of mouth. Interested families completed an online survey to screen for eligibility and consent to participate. The current study analyzed cross-sectional data collected prior to the intervention (for details about the intervention, see Gewirtz et al., 2017a). All study procedures were approved by the University of Minnesota's Institutional Review Board.

Online survey. Participants received an online link to access the survey which included demographic information, deployment-related questions and psychological measures.

In-home physiological data collection and family interaction tasks. Families were scheduled to complete an in-home assessment, administered by 2-3 trained technicians. Family members were guided to put on a Polar heart rate monitor (Model: RS800CX) for inter-beat intervals (IBIs) recording. Previously, researchers have validated this method for heart rate variability research (Nunan et al., 2009; Nunan et al., 2008; Quintana, Heathers, & Kemp, 2012), suggesting that HF-HRV measures obtained with the Polar had no significant bias or additional random error in comparison with criterion measures (i.e. electrocardiography method) (Nunan et al., 2009)[6]. While wearing the Polar monitors, family members were videotaped engaging in a series of structured family interaction tasks.

Family members were presented with a list of family issues that may cause conflicts between parents and the child (e.g., "making too much noise at home"), and rated the degree to which each issue had been a "hot topic" in the family in the past two weeks (0 = Irrelevant, 1 = Not at all "hot", 2 = "Hot", 3 = "Boiling hot"). The identified issues were utilized for conflict resolution. For deployment discussion tasks, parents selected a deployment-related issue which caused distress or conflict. The family interaction tasks used in the current study consisted of 1) father/mother reading a neutral story to the child[7]; 2) a father-child conflict resolution task; 3) a father-(mother)-child conflict resolution task; 4) a father-(mother)-child collaborative toy play task; and 5) a father-child deployment discussion. Each task lasted 4-5 minutes. At the end, family members were instructed to take off their heart rate monitors and debriefed. The order of

[6] But the authors noted that the conclusion may not be generalizable to data collected over longer periods (e.g., >10minutes).

[7] In most of the cases, mother was also participating in the task, in which case the order of which parent read first was balanced. A small portion of the sample read a "Smiley bunny" story (n = 13) whereas most families read "Adelie penguin" and "American bullfrog" (n = 79). Independent sample t-tests were conducted, and no significant differences were detected. Thus, families who read the "Smiley bunny" story were also included in analyses.

the tasks was counter-balanced between fathers and mothers: specifically, half of fathers completed the father-child conflict resolution task immediately after the reading task, whereas the second half of the fathers completed a different task in between the reading and father-child conflict resolution tasks.

Physiological data processing. Video tapes of family interaction tasks were time-stamped in BORIS software (Friard, Gamba, & Fitzjohn, 2016) such that heart rate data could be tagged by task. IBIs data were processed in the RHRV program (Martínez et al., 2017). RHRV has the capability to process all data at once without individual data screening and processing. Because no validation study exists for the program, data from two family interaction tasks among the father sample were also processed in Kubios – a widely used software for HRV data analysis (Tarvainen, Niskanen, Lipponen, Ranta-aho, & Karjalainen, 2014). The HRV values extracted from RHRV and Kubios were strongly correlated (*r*s > 0.8), suggesting that RHRV is reliable and valid.

Measures

Demographic variables. Annual household income, marital status (0 = married; 1 = not married), years of marriage, and child age/sex (1 = boy; 2 = girl) were included as control variables in the analyses. Annual household income was categorized as 1 = less than $10,000; 2 = $10,000 – 19,999; … 15 = $140,000 – 149,999; 16 = more than $150,000.

Times and length of deployment. Fathers answered two questions about their deployment experience: "What is the total number of times you have been deployed in the current conflicts (since 2001)?", "For the number of deployments that you indicated above, what is the total number of months that you were deployed?". Answers for cumulative months of deployments were on a scale of 0 – 7 (0 = no deployment in the current conflict; 1 = 6-months or less; 2 = 7~12 months; 3 = 13~18 months; … 6 = 31~36 months; 7 = 37 months or more).

Assessment time. In-home assessments were conducted at different times in a day, which can affect HF-HRV measures (Laborde, Mosley, & Thayer, 2017). Times of a day for when physiological assessment started were extracted from the Polar.

Medication status. Fathers were asked to indicate what medications they were using. The medication types/names were evaluated to determine their possible effects on vagal tone based on the literature and consultations with a pharmacist. Answers were categorized as 0 = no effects or no medication use; 1 = low priority medication; and 2 = high priority medication (e.g., beta blockers). As mentioned above, one father who had a value of 2 was excluded from analysis.

Alcohol use. The Alcohol Use Disorder Identification Test (AUDIT: Babor, Higgins-Biddle, Saunders, & Monteiro, 2001) was used to assess alcohol use problems because alcohol use problems may be a confounding variable for HRV data. The scale has 10 items and a composite score was calculated such that higher scores indicate more alcohol use.

PTSD symptoms. The military version of the Posttraumatic Stress Disorder Checklist (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993) was used to assess posttraumatic symptoms related to military experience. Respondents were asked to rate 17 items on a 5-point scale (1 = not at all; 5 = extremely), with each item indicating the severity of symptoms, for instance, “repeated, disturbing dreams of a stressful military experience”, “trouble falling or staying asleep”, and “feeling emotionally numb or being unable to have loving feelings for those close to you”. A composite score was calculated by summing up all items, such that higher scores indicate greater severity of PTSD symptoms.

Vagal flexibility (VF). Repeatedly for every 30-sec of the reading task and the conflict resolution task by father-child, high frequency and low frequency absolute spectral powers (unit: ms^2) were calculated and subsequently a *normalized unit* was computed in each 30-sec window (HFnu = high frequency powers divided by the total of high frequency and low frequency powers; possible range: 0 to 100). A median of the repeated 30-sec HFnu values was taken to indicate HF-HRV during reading task (task 1) and HF-HRV during conflict resolution (task 2). Finally, vagal flexibility was computed as the difference between the two HFnu values such that higher vagal flexibility indicates greater changes in cardiac vagal tone (which can range between -100 to 100).

Experiential Avoidance (EA). Experiential Avoidance was assessed with the Acceptance and Action Questionnaire – II (AAQ-II; Bond et al., 2011). The AAQ-II is a unidimensional scale with 7 items (e.g., “I’m afraid of my feelings”); respondents rate each item on a 7-point scale (1 = never true, 7 = always true). Items include “Worries get in the way of my success” and “I worry about not being able to control my worries and feelings.” The Cronbach’s α was above .90, showing an acceptable internal consistency reliability. A composite score was created such that higher score indicates higher level of experiential avoidance.

Observed parenting behaviors. The Macro-Level Family Interaction Coding Systems (MFICS) was developed to measure observed emotion-related parenting behaviors with children aged between 5 to 15 years (Snyder, 2014). It is emotion-related parenting because it focuses more on basic relationship orientations (approach vs. avoidance, or positive vs. negative) rather than specific, theory-driven behaviors involved in parents (e.g., discipline). A prior study reported the factor analyses of this coding system (Brockman et al., 2016). Four parenting categories were focused in the current study: positive engagement, withdrawal avoidance, reactivity coercion, and distress avoidance. *Positive engagement* described a generalized pattern of attentive, cooperative, responsive, and warm behavior (13 items; “actively initiates,” “is responsive socially,” “shows interest”). *Withdrawal avoidance* focused on parents’ lack of engagement/energy, disinterest, non-responsiveness, and distancing/passive behaviors (9 items; “Is emotionally unavailable, ‘not there’,” “Displays a restricted range of emotions,” “Is distant, inattentive or unengaged in ongoing discourse and joint activity”). *Reactivity coercion* reflected parents’ irritability, bossiness, nattering and persistent negativity that may be accompanied by aversive escalation (14 items; “Is irritable and grumpy”, “Is bossy”, “Reciprocates aversive actions of others”). *Distress avoidance* assessed a unique way in which parents react to the aversive behavior or affective distress of their child through rapid soothing and minimizing the other person’s distress while at the same time showing fear, wariness, ignoring, and low empathy (10 items; “sooth and problem-solve other’s distress”, “fearful, anxious”, “little interest or empathy in other’s ideas”). Items were rated by trained coders on a 5-point scale (1 = not descriptive at all; … 5 = very clearly descriptive). To calculate a composite score across tasks for each factor, the four tasks that involved father-child were used: a conflict resolution task by father-child, a conflict resolution task by father-(mother)-child, a collaborative toy play task by father-(mother)-child, and a deployment discussion task by father-child (task 2, 3, 4, and 5). The same set of tasks with the exception of the toy-play task were used for distress avoidance.

Child behavior problems. All fathers and 96% mothers reported child externalizing behaviors using the Behavior Assessment System for Children (2nd Edition) – Parent Rating Scale (BASC-2-PRS; Reynolds & Kamphaus, 2004). Two versions of the BASC-2-PRS were administered: the child (normed for age 5-11) and the adolescent form (normed for ages 12-21; about 10% of the families in our sample were given the adolescent form). All items were rated on a scale of 1 (never) to 4 (almost always). Age-specific normative scores were then calculated using a large, nationally representative sample in the form of T-scores with a mean of 50 and a standard deviation of 10. A composite score of child behavior problems was created by averaging the three subscales: conduct problems, hyperactivity, and aggression. Mother- and father-reported T-scores were averaged. The BASC-2-PRS showed acceptable reliability in this sample: the Cronbach's αs were above .90.

Analyses

Descriptive analysis was conducted for key study variables. An interaction term (EAxVF) was calculated as the product of mean-centered EA and mean-centered VF. Multiple regression was conducted to determine the linear combination of variables for predicting positive engagement, withdrawal avoidance, reactivity coercion, and distress avoidance in four separate models, and in particular, to test whether VF and/or EAxVF uniquely predicted parenting above and beyond EA. Covariates were controlled in all models.

Missing data

In this sample, EA, marital status, and years of marriage variables each had one case with missing values, and annual household income variable had two cases with missing values. SPSS 23 uses list-wise deletion for multiple regression analyses.

Results

Bivariate correlations showed that VF was not correlated with alcohol use and time of assessment (*r*s = -.05, .14, respectively, *n.s.*). There was also no significant difference in VF between fathers who completed the two tasks continuously and those who completed a different task in between the two, t (90) = .28, *n.s.*. A total of 9 fathers (9.8%) had a value of 1 on medication status (low priority medication), and a *t*-test was conducted to examine if medication status had an impact on fathers' VF, and results showed no such significant impact, *ts* = 1.22, *df* = 90, *n.s.*. Since they were unrelated to VF, alcohol use, time of assessment, and medication status were not controlled in models.

Descriptive statistics and intercorrelation of the key variables are presented in Table 1. At bivariate levels, VF was not correlated with parenting behaviors, although it was significantly correlated with PTSD symptoms (r = -.21, p < .05). EA was correlated with positive engagement and withdrawal avoidance, but not with reactivity coercion or distress avoidance. Positive engagement was highly correlated with withdrawal avoidance (r = -.77, p < .001) and moderately correlated with reactivity coercion (r = -

.38, $p < .001$). Reactivity coercion was weakly correlated with distress avoidance ($r = .28$, $p < .01$).

As shown in Table 2, hierarchical linear regression analyses of positive engagement as the dependent variable were computed in SPSS in four steps. Assumptions of multiple regression were checked and met. Specifically, step 3 and 4 were to examine whether VF and the interaction EAxVF predicted positive engagement above and beyond EA, while controlling for a set of child and father covariates. In step 3, when VF was added to the model, it did not account for significant variance in positive engagement. Subsequently in step 4, when EAxVF was added, it significantly accounted for an additional 4.9% of the variance in positive engagement above and beyond experiential avoidance and other covariates, F change = 5.769, $p < .05$. This final model (Model 4) was significant, $F(12, 76) = 3.558$, $p < .001$. Including child age/sex/behavior problems, family income, father marital status, years of marriage, deployment times/length, PTSD symptoms, EA, VF, and EAxVF, the final model yielded an adjusted R squared value .259, indicating that 25.9% of the variance in positive engagement were explained by the model, which is a large effect size according to Cohen (1988). While accounting for covariates, EAxVF was positively associated with positive engagement, indicating that fathers with low vagal flexibility showed strong negative association between EA and positive engagement, whereas those with medium or high vagal flexibility showed weak or no association between experiential avoidance and positive engagement. After subgrouping the sample into low-, mid-, and high-VF groups, the bivariate correlations between EA and positive engagement were -.55 ($p < .01$), -.21

(*n.s.*), and -.09 (*n.s.*), respectively (Figure 1). Moreover, in the final model, child age (β = -.25), family income (β = .31), and EA (β = -.38) were significantly associated with positive engagement (ps < .05).

As shown in Table 3, hierarchical linear regression analyses of withdrawal avoidance as the dependent variable were computed in four steps. Assumptions of multiple regression were checked and met. When VF was added to the model (step 3), it did not account for significant variance in withdrawal avoidance. When EAxVF was added (step 4), it significantly accounted for an additional 4.1% of the variance in withdrawal avoidance above and beyond EA and other covariates, F change = 4.237, p < .05. The final model (Model 4) was significant, F (12, 76) = 2.235, p < .05. Including the predictors, the final model yielded an adjusted R squared value .144, indicating that 14.4% of the variance in withdrawal avoidance were explained by the model, which is a medium effect size. While accounting for covariates, EAxVF was negatively associated with withdrawal avoidance, indicating that fathers with low or medium VF showed moderate positive association between EA and withdrawal avoidance, whereas those with high VF showed no association between EA and withdrawal avoidance. After subgrouping the sample into low-, mid-, and high-VF groups, the bivariate correlations between EA and withdrawal avoidance were .41 (p < .05), 35 (p = .05), and -.04 (*n.s.*), respectively (Figure 2). Moreover, in the final model, EA was significantly associated with withdrawal avoidance (β = .42, p < .05).

Regression models with the same set of covariates were computed to predict reactivity coercion and distress avoidance separately, but none of the predictors were associated with reactivity coercion and distress avoidance.

Discussion

To our knowledge, this is the first study testing the interaction of self-reported emotion regulation (experiential avoidance; EA) with a physiological index of emotion regulation (vagal flexibility; VF) on observed parenting behaviors in post-deployed military fathers. While we did not find any main effects of VF on any observed parenting measures, we found significant interaction effects of EAxVF on positive engagement and withdrawal avoidance, but not on reactivity coercion or distress avoidance. Specifically, fathers with poorer VF exhibited a stronger relationship between EA and positive engagement/withdrawal avoidance while fathers with higher VF showed no relationship between EA and positive engagement/withdrawal avoidance.

Positive engagement and withdrawal avoidance were highly correlated in this sample ($r = -.77$, $p < .001$). They address the opposite behavioral patterns of fathers during father-child interactions. Fathers with high levels of positive engagement exhibit interests, support, warmth, and sensitivity, express joy and happiness openly, and validate their children's negative emotions with empathy (Snyder, 2014). In contrast, fathers with high withdrawal avoidance show disengagement, disinterest, and non-responsiveness. They may use a palliative approach to coping or avoid upsetting another family member with a sense of "walking on egg shells" (Snyder, 2014). Previously, Brockman et al. (2016) found that fathers with psychological flexibility (i.e., low EA) was associated with positive engagement. We found that VF interacted with EA to account for fathers' positive engagement and withdrawal avoidance. These findings show consistency with polyvagal theory (Porges, 2011) suggesting that VF supports one's social engagement behaviors. Furthermore, VF may reflect a distinct aspect of emotion regulation from an interpersonal, relational view (i.e., context-dependent emotion regulation) (Campos, Walle, Dahl, & Main, 2011). VF may enable fathers with high EA to stay socially engaged with their children, regardless of their own distress. In fathers with low VF, however, EA had spill-over effects to the parenting domain – fathers with high levels of psychological inflexibility showed low positive engagement and high withdrawal avoidance if their physiological flexibility was also low.

Furthermore, VF may indicate some unique aspects of emotion regulation and psychological flexibility at an intrapersonal level that are not captured by EA. For example, lower baseline RSA was found to be associated with a lack of emotional clarity and impulse control, both dimensions of difficulties in emotion regulation (Williams et al., 2015). Others have tested the relationship between vagal functioning and compassion for one's own pain and those of others (Kirby, Doty, Petrocchi, & Gilbert, 2017; Stellar, Cohen, Oveis, & Keltner, 2015). Constructs such as impulse control and compassion may have implications for some of the specific underlying mechanisms of VF for predicting positive engagement and/or withdrawal avoidance. Further investigations are warranted.

Neither VF nor the interaction between VF and EA was associated with reactivity coercion or distress avoidance. Reactivity coercion is conceptually distinguishable from avoidance; it represents an excessive sensitivity to neutral or negative stimulus and the uses of “force” to control others through negativity. Neurobiological systems that may underlie reactivity coercion include the mesolimbic dopamine system, the hypothalamic-pituitary-adrenal system, and prefrontal cortex (Snyder, 2015). Indeed, researchers found that the influence of combat trauma on military fathers’ reactivity coercion via PTSD symptoms was moderated inhibitory control, a key component of executive functions supported by prefrontal cortex (Monn, Zhang, Gewirtz, & Snyder, in press). Notably, the variance of reactivity coercion was the least among the parenting measures, which may explain our null findings. On the other hand, distress avoidance is a post-hoc factor in the coding system and consists of a mix of positive engagement and withdrawal avoidance items. Unlike withdrawal avoidance, it has a motivational component in which parents react to children’s distress. More research is needed to elucidate distress avoidance before any conclusions can be drawn.

This study contributes to the literature by showing that VF buffers individuals against negative outcomes associated with known risk factors. It echoes many existing studies on this topic that focused on children’s RSA (Leary & Katz, 2004; Perry, Calkins, Nelson, Leerkes, & Marcovitch, 2012; Taylor, Eisenberg, & Spinrad, 2015). For instance, Leary and Katz (2004) found that children’s VF moderated the relationship between hostile-withdrawn co-parenting and children’s peer conflict. Moreover, a multi-wave longitudinal study suggested a bidirectional relationship between observed maternal sensitivity and child VF in preschool-aged children (Perry, Mackler, Calkins, & Keane, 2014). Future researchers should conduct multi-method analyses and accumulate rigorous findings to illuminate the complex relationships regarding parental VF, parental emotion regulation, parenting, and child VF.

The current study has several limitations. First, this is a cross-sectional study and no causal inference can be made. Second, HF-HRV during a reading task is an approximation of baseline RSA, and thus we were unable to test whether baseline RSA also moderated the relationship between EA and parenting. Third, items of reactivity coercion and those of distress avoidance were found with relatively low ICCs (0.47 and 0.53, respectively; Brockman et al., 2016), which suggest further investigations about the psychometric validity of these two factors. Finally, the findings in post-deployed fathers may not be generalizable to other family contexts.

Notwithstanding its limitations, this study has strengths and significantly contributes to the literature. It used multi-level variables of emotion regulation and psychological flexibility (self-report and physiology) and assessed parenting behaviors with observational data. This avoided common method bias. Moreover, structured family interactions were administered at home, which not only increased the ecological validity of the parenting measures, but also presented a method to measure cardiac vagal tone in a more natural setting of parenting instead of a controlled laboratory-based setting.

Table 1. Descriptive statistics and intercorrelations of key variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Child age	1														
2 Child sex	-.13	1													
3 Child behaviors	-.15	-.25*	1												
4 Income	.18	-.03	-.24*	1											
5 Marital status	.02	.10	-.02	.30***	1										
6 Years of marriage	.43***	-.04	-.08	.40***	.46***	1									
7 Deployment times	.10	.03	-.02	.03	.09	.27*	1								
8 Deployment length	.00	.18	-.15	.03	.11	.00	.48***	1							
9 PTSD symptoms	.05	-.07	.08	-.07	-.24*	-.19	-.07	-.07	1						
10 EA	-.08	.01	.10	.03	-.17	-.09	.09	-.08	.66***	1					
11 VF	-.02	.01	-.11	.10	.10	.08	-.18†	-.10	-.21*	.02	1				
12 Positive engagement	-.17	-.05	.00	.27*	.13	.05	-.14	.08	-.26*	-.34***	.14	1			
13 Withdraw avoidance	.07	.17	-.09	-.16	-.12	-.08	.04	-.10	.19	.31***	-.07	-.77***	1		
14 Reactive Coercion	.12	-.03	.12	-.08	-.09	.05	.10	.01	.16	.08	-.09	-.38***	.13	1	
15 Distress Avoidance	-.23*	.02	.03	-.14	-.01	-.03	-.02	.02	-.06	-.04	-.03	-.16	.09	.28*	1
M	8.86	1.45	51.71	8.63	0.92	8.80	2.09	3.92	1.43	15.51	3.52	3.51	1.34	1.07	0.79
SD	2.71	0.50	6.71	3.44	0.27	5.59	1.18	1.76	0.14	7.55	13.22	0.55	0.36	0.22	0.42

Note: † *p<.10, * p<.05, ** p<.01, ***p<.001*. EA = experiential avoidance; VF = vagal flexibility.

Table 2. Summary of hierarchical regression analysis predicting positive engagement

	Model 1			Model 2			Model 3			Model 4		
Variable	B	SEB	*β*	B	SEB	*β*	B	SEB	*β*	B	SEB	*β*
1 Child age	-0.05	0.02	-.22†	-0.05	0.02	-.26*	-0.05	0.02	-.26*	-0.05	0.02	-.25*
2 Child sex	-0.10	0.11	-.10	-0.08	0.11	-.07	-0.07	0.11	-.07	-0.04	0.11	-.04
3 Child behaviors	0.01	0.01	.07	0.01	0.01	.09	0.01	0.01	.10	0.01	0.01	.13
4 Income	0.04	0.02	.26*	0.05	0.02	.31**	0.05	0.02	.31**	0.05	0.02	.31**
5 Marital status	-0.05	0.24	-.03	-0.10	0.23	-.05	-0.11	0.23	-.06	-0.14	0.23	-.07
6 Years of marriage	0.01	0.01	.05	0.01	0.01	.06	0.01	0.01	.06	0.01	0.01	.08
7 Deployment times	-0.13	0.06	-.28*	-0.10	0.06	-.20†	-0.08	0.06	-.17	-0.07	0.06	-.14
8 Deployment length	0.07	0.04	.21†	0.05	0.04	.16	-0.05	0.04	.16	0.05	0.03	.16
9 PTSD symptoms	-0.01	0.01	-.26*	-0.00	0.01	-.04	0.00	0.01	.01	0.01	0.01	.12
10 EA (mean-centered)				-0.02	0.01	-.33*	-0.03	0.01	-.37**	-0.03	0.01	-.38**
11 VF (mean-centered)							0.01	0.00	.12	0.01	0.00	.17
12 EAxVF										0.00	0.00	.25*
R^2		.247			.299			.311			.360	
ΔR^2		.247			.052			.013			.049	
Adjusted R^2		.161			.209			.213			.259	
F Change		2.873**			5.771*			1.405			5.769*	

Note: † *p<.10, * p<.05, ** p<.01, ***p<.001*. EA = experiential avoidance; VF = vagal flexibility.

Table 3. Summary of hierarchical regression analysis predicting withdrawal avoidance

	Model 1			Model 2			Model 3			Model 4		
Variable	B	SEB	β	B	SEB	β	B	SEB	β	B	SEB	β
1 Child age	0.01	0.02	.10	0.02	0.02	.14	0.02	0.02	.14	0.02	0.02	.14
2 Child sex	0.15	0.08	.20†	0.13	0.08	.18†	0.13	0.08	.17	0.11	0.08	.15
3 Child behaviors	-0.01	0.01	-.12	-0.01	0.01	-.14	-0.01	0.01	-.15	-0.01	0.01	-.18
4 Income	-0.02	0.01	-.15	-0.02	0.01	-.21†	-0.02	0.01	-.21†	-0.02	0.01	-.21†
5 Marital status	-0.03	0.17	-.03	0.00	0.16	.00	0.01	0.17	.01	0.02	0.16	.02
6 Years of marriage	0.00	0.01	-.05	0.00	0.01	-.06	0.00	0.01	-.06	0.00	0.01	-.07
7 Deployment times	0.05	0.04	.15	0.02	0.04	.06	0.01	0.04	.04	0.00	0.04	.01
8 Deployment length	-0.04	0.03	-.18	-0.03	0.03	-.13	-0.03	0.03	-.13	-0.03	0.02	-.13
9 PTSD symptoms	0.01	0.00	.18	0.00	0.00	-.07	.00	0.01	-.11	-0.01	0.01	-.21
10 EA (mean-centered)				0.02	0.01	.37*	0.02	0.01	.41**	0.02	0.01	.42*
11 VF (mean-centered)							0.00	0.00	-.10	0.00	0.00	-.14
12 EAxVF										0.00	0.00	-.23*
R^2		.145			.211			.220			.261	
ΔR^2		.145			.067			.008			.041	
Adjusted R^2		.047			.110			.108			.144	
F Change		1.485			6.588*			0.819			4.237*	

Note: † *p<.10, * p<.05, ** p<.01, ***p<.001.* EA = experiential avoidance; VF = vagal flexibility.

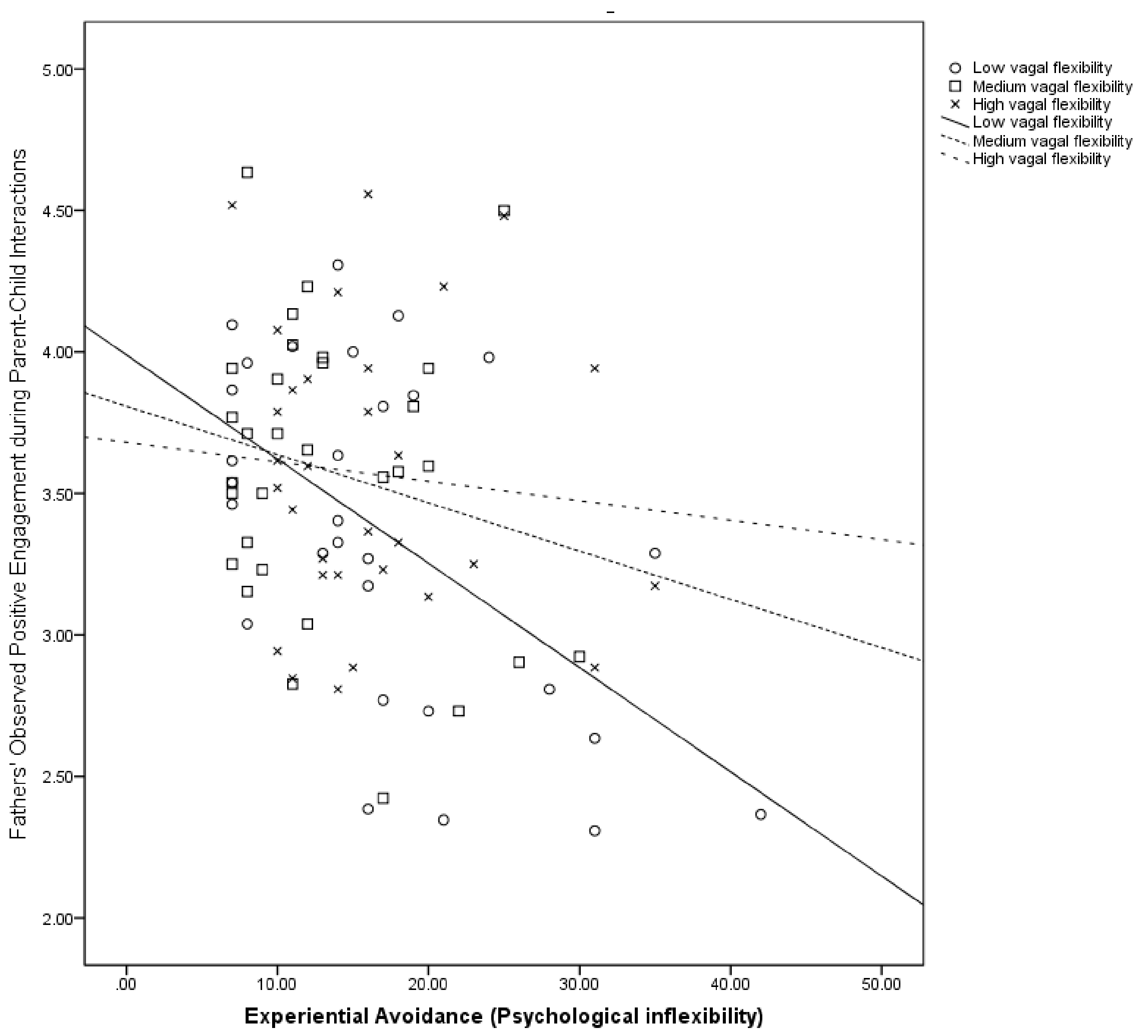

Figure 1. Vagal flexibility moderates the association between experiential avoidance and positive engagement.

Note: Bivariate correlations between experiential avoidance and positive engagement were -.55 (p < .01), -.21 (*n.s.*), and -.09 (*n.s.*) for low-, mid-, and high-vagal flexibility subgroups, respectively.

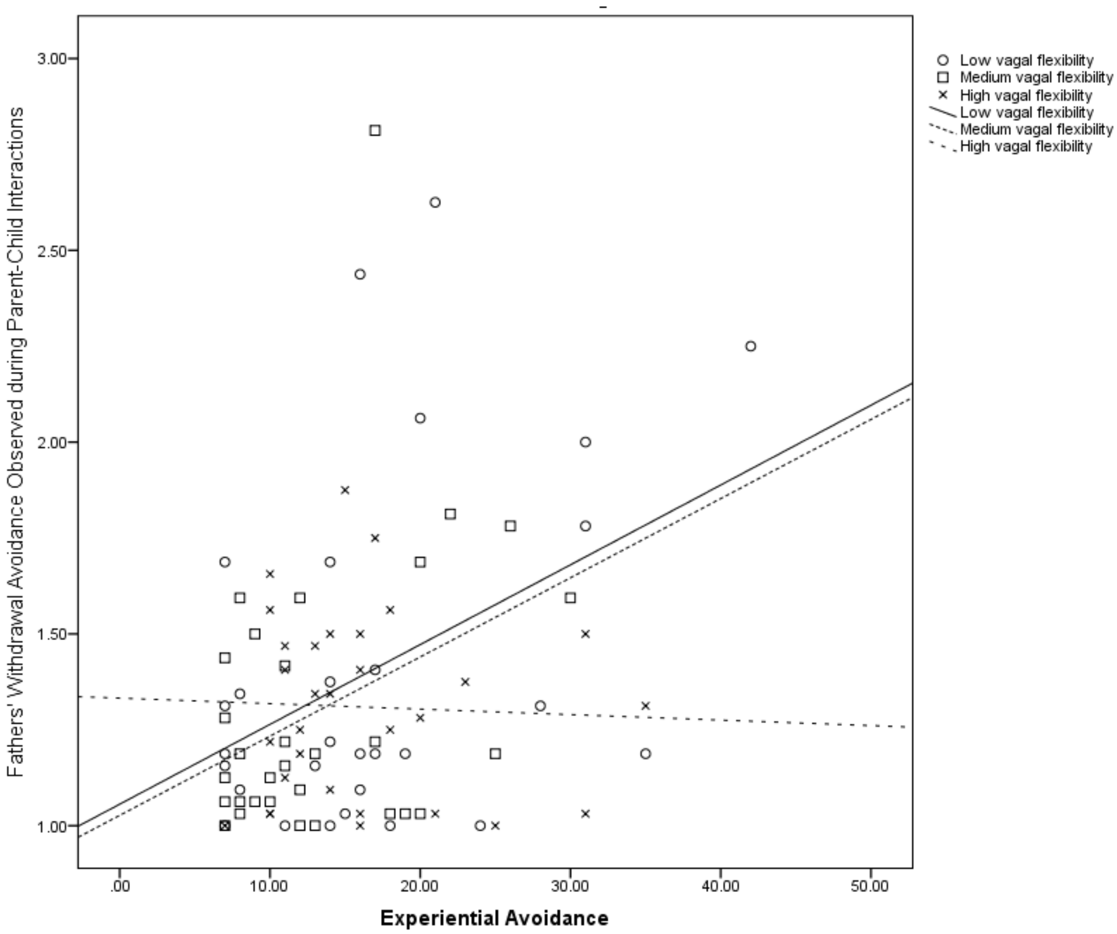

Figure 2. Vagal flexibility moderates the association between experiential avoidance and withdrawal avoidance.

Note: Biivariate correlations between experiential avoidance and withdrawal avoidance were .41 ($p < .05$), 35 ($p = .05$), and -.04 (*n.s.*) for low-, mid-, and high-vagal flexibility subgroups, respectively.

MANUSCRIPT TWO

Adapting to “ADAPT”: Vagal flexibility predicts military fathers’ changes in parenting following a parent training program

Synopsis

Research have documented that children of deployed parents are at elevated risk of mental health problems**.** As parenting is a crucial mediator buffering against the negative impact of stressful events on children, efforts have been made to evaluate parenting interventions to promote child adjustment. However, to serve families more effectively, evidence is needed to understand what individual characteristics can predict intervention responsiveness. Vagal flexibility denotes dynamic changes in cardiac vagal tone and reflects emotion regulation and social engagement behaviors. The current study tested military fathers' vagal flexibility as a moderator predicting their responsiveness to a parent training program in a randomized controlled trial - the After Deployment Adaptive Parenting Tools/ADAPT. Enrolled families with a child aged between 4-12 years were randomized into a 14-week intervention or a control group. Data drawn from 145 families consisting of a post-deployed father were analyzed using structural equation modeling. Vagal flexibility was measured by the difference in cardiac vagal tone from a neutral task to a conflict resolution task. Parenting behaviors were measured by a series of structured family interaction tasks yielding an overall positive parenting score including subscales for positive involvement, problem-solving, encouragement, monitoring, and discipline. Results showed that vagal flexibility significantly moderated fathers' intervention responsiveness, such that fathers with high vagal flexibility showed significantly improved parenting at 1-year follow-up if they were randomized into the ADAPT. The findings contribute to the literature on precision-based prevention programs by assessing a physiological indicator as a tailoring variable. The findings have important

implications for parenting interventions with post-deployed military fathers.

Since 2001 9/11, Operations Enduring, Iraqi Freedom (OEF/OIF), and New Dawn have resulted in prolonged and repeated deployments of large numbers of U.S. military personnel to Afghanistan and/or Iraq. Deployment places unique challenges and stressors on service members and their families. The lives of about two million American children have been directly affected by the deployment of a parent (U.S. Department of Defense, 2014). While many military children are resilient and do not endorse psychopathology (Park, 2011), a growing body of literature has documented that school-aged children of deployed parents reported elevated rates of mental health problems including sleep problems, psychosocial morbidity, and anxiety in comparison with non-deployed military children or national norms (Card et al., 2011; Flake, Davis, Johnson, & Middleton, 2009; Gorman, Eide, & Hisle-Gorman, 2010; Lester et al., 2010; Millegan, Engel, Liu, & Dinneen, 2013; Wadsworth, Bailey, & Coppola, 2017). Untreated mental health problems during childhood can continue and be exacerbated over adolescence and adulthood. Thus, child mental and behavioral problems have been a focus in prevention research.

Parenting is a crucial mediator buffering against the negative impact of stressful events on children (Conger et al., 1992). In the past few decades, researchers have tested a substantial set of parenting interventions to improve parenting and thus reduce child behavioral problems (Forgatch, Patterson, & Gewirtz, 2013). For example, Parent Management Training – Oregon Model (PMTO) was developed based on Social Interaction Learning (SIL) theory (Forgatch & Patterson, 2010). The model emphasizes parental influences on child development. Parents can create a positive family environment by using effective discipline, monitoring, positive involvement, skill encouragement, and problem solving. On the other hand, parents can create a coercive family environment by using negative reciprocity, escalation, and negative reinforcement. Evidence from several randomized trials have shown that parenting intervention is a promising approach to improving parenting and reducing child behavioral problems (Forgatch & Gewirtz, 2017).

Deployment-related stressors such as posttraumatic stress symptoms may compromise effective parenting (Gewirtz, Polusny, DeGarmo, Khaylis, & Erbes, 2010). However, studies regarding evidence-based programs designed to enhance effective parenting for military families is insufficient (Gewirtz, Pinna, Hanson, & Brockberg, 2014). Against this backdrop, the current study focused on the After Deployment Adaptive Parenting Tools/ADAPT program, which was developed to enhance parenting practices and subsequently to reduce child mental and behavioral problems in post-deployed military families. A previous report drew data from a randomized controlled trial (RCT) of the ADAPT and showed its efficacy in improving effective co-parenting practices at 1-year follow-up (Gewirtz et al., 2017a). In this study, we built on those findings and tested vagal flexibility – a physiological measure of emotion regulation, psychological flexibility, and social engagement behaviors – as an intervention moderator predicting differential responsiveness to the ADAPT program in fathers.

Cardiac vagal tone, PTSD, and parenting

In the mental health literature, one physiological construct that has increasingly attracted attention is cardiac vagal tone, or heart rate variability (HRV) (Porges, 1995). The vagus nerve (the 10th cranial nerve) is the major tract of the parasympathetic nervous system (PNS), which connects to the heart as well as many other organs. Several theorists have conceptualized the behavioral meanings of HRV (Laborde et al., 2017). In particular, polyvagal theory (Porges, 2007, 2011) suggests that the myelinated mammalian vagus undergirds human emotion regulation and social engagement behaviors. Specifically, the vagus nerve serves as a "brake" to slow heart rate and plays a critical role in the capacity to regulate biobehavioral responses under environmental challenges. The control over heart rate can be measured through HRV. Specifically, a widely studied measure is the high frequency component of HRV (HF-HRV) - a reliable and valid measure of cardiac vagal tone, also called respiratory sinus arrhythmia (RSA) in the literature (Laborde et al., 2017).

Baseline RSA reflects one's general level of parasympathetic functioning or emotion reactivity. It is typically measured during a resting state. Low baseline RSA has been associated with a number of mental health problems such as depression (Rottenberg, 2007), anxiety (Chalmers, Quintana, Abbott, & Kemp, 2014), and combat-related PTSD (Minassian et al., 2014). Pyne et al. (2016) showed that pre-deployment PTSD interacted with baseline RSA in predicting post-deployment PTSD among post-deployed service members. Specifically, soldiers with higher pre-deployment PTSD symptoms plus poor baseline RSA were at elevated risk for post-deployment PTSD. On the other hand, vagal flexibility ("phasic HRV," "vagal withdrawal," "vagal reactivity," "vagal suppression," or "vagal regulation") represents one's capacities to release the vagal "brake," accelerate the heart rate, and increase metabolism, as ways to engage in a stressful environment without compromising control. It is typically calculated through HRV *changes* between two different time points from baseline to a stressful situation (i.e., coping with an environmental challenge).

Some studies have yielded different data regarding the benefit of high baseline RSA. Butler et al. (2006) found that women with higher (vs. lower) baseline RSA experienced and expressed more negative emotion after viewing an upsetting film as they were discussing the film. Pu et al. (2010) found that individuals with high baseline RSA *suppressed* more negative emotions in response to a negative film clip than those with low baseline RSA, but they *experienced* comparable levels of negative feelings. Furthermore, the high baseline RSA group had poorer performance in a subsequent cognitive task relative to the low baseline RSA group. The authors argued that high baseline RSA may index decreased negative emotional expression but not necessarily signal effective emotion regulation strategies since expressive suppression is socially maladaptive (Pu et al., 2010).

In accordance with polyvagal theory, vagal flexibility may have more important implications for emotion regulation under stress relative to baseline RSA: rapid flexibility of cardiac vagal tone under stressful situations can facilitate emotional processes and allow the body to optimally cope with challenges (Porges, 2011). Empirically, vagal flexibility has predicted recovery from depression (Rottenberg, Salomon, Gross, & Gotlib, 2005) as well as sensitivity to emotional information in a social context (Muhtadie et al., 2015). Relevant to the current study, vagal flexibility was found to moderate the impact of psychological inflexibility (i.e., experiential avoidance) on parenting in military fathers: high vagal flexibility buffered the negative relationship between experiential avoidance and poor parenting (Manuscript 1). Finally, some studies with civilian samples have shown an association between parental vagal flexibility and parenting, although most of them have focused on mothers. For example, stressed mothers (i.e. those with high salivary cortisol levels) exhibited more negative intrusiveness with their children if their vagal flexibility was lower vs. higher (Mills-Koonce et al., 2009). Connell et al. (2017) showed that high vagal flexibility was associated with less expressions of parental anger during parent-child interactions in a predominantly mother sample.

Identifying moderators of intervention outcomes in ADAPT program

Not much is known about the factors that magnify or lessen the impact of preventive interventions on individual functioning. To improve effect sizes of interventions, researchers have made efforts to identify pre-existing individual characteristics that can predict varying responsiveness, which will eventually help tailor interventions and maximize outcomes (Gardner, Hutchings, Bywater, & Whitaker, 2010). In a previous report, it was found that fathers who were randomized into the ADAPT program failed to show desirable changes in parenting if they had very high levels of PTSD symptoms (i.e. more than 2 SD above the mean) prior to the intervention (Chesmore, Piehler, & Gewirtz, 2017). Only 15 of the sample of 294 fathers fell into this category and for most fathers who did not meet the criteria for a PTSD diagnosis, there is still a lingering question about what individual characteristics might predict their intervention responsiveness.

Vagal flexibility may be a potential moderator for predicting post-deployed fathers' responsiveness to the ADAPT program, given its implications for emotion regulation and social engagement behaviors – both are important for effective parenting practices. Moreover, assessing vagal flexibility during father-child interactions helps to capture the physiological component of emotion regulation embedded in a parenting context. Furthermore, Fishbein and Dariotis (2017) argued that testing observable behavior, surveys, and background characteristics have been unable to substantially improve effect sizes of intervention programs so far. And the field of personalized prevention may benefit from investigating individuals' neurobiological characteristics as tailoring variables because these characteristics are important mechanisms underlying behaviors and have been understudied in the past.

The current study

According to the differential susceptibility hypothesis, not only do individuals exhibit worse outcomes under adverse conditions (e.g., trauma), but they also exhibit better outcomes under favorable conditions (e.g., an intervention) (Belsky & Pluess, 2009). Consistent with this hypothesis, Monn et al. (in press) showed that the link between combat trauma and PTSD symptoms were moderated by inhibitory control, an aspect of executive function related to prefrontal networks. Specifically, post-deployed fathers with stronger inhibitory control appeared to exhibit more PTSD symptoms if they were exposed to combat trauma, relative to fathers with poorer inhibitory control. In other words, fathers at lower risk exhibited more negative outcomes than those at higher risk if they were exposed to adverse environments. We hypothesized that post-deployed fathers at lower risk – those with better vagal flexibility - would show greater improvements in parenting practices at 1-year follow-up if they were randomized into the ADAPT intervention relative to those with poorer vagal flexibility.

Methods

Sample

The sample included 145 post-deployed military fathers, their children, and their partners (if applicable), who participated in an RCT of the ADAPT program (See Figure 3 for a participant flow diagram). A total of 137 post-deployed fathers were excluded from the original RCT sample (n = 282) because of the following reasons: a reading task was not administered (n = 54); fathers refused to wear equipment or did not participate (n = 3); HRV data was irretrievable due to administrative errors or equipment malfunctions (n = 39); times of family interaction tasks were unavailable due to video-recording problems (n = 19); HRV data had excessive artifacts (n = 11); family interaction tasks were conducted in a classroom setting (vs. family homes) (n = 8)[8] or constantly interrupted by a second child other than the target child (n = 1); and fathers used medication that affects vagal tone (n = 2).

Independent-sample *t*-tests and chi-square tests were performed to compare if there were key differences on demographic variables between fathers who were included in the analyses and those who were not. No significant individual or familial differences were found. However, a significant difference was detected with respect to child sex, $\chi^2 = 5.85$, $p < .05$. Specifically, the fathers included in this study were more likely to have a

[8] Family interaction took place in a classroom setting is, to some degree, similar to a laboratory experiment, whereas family interaction took place at home resembles a naturalistic environment. Gardner (2000) reviewed the literature on parent-child interactions and concluded that interactions in artificial settings are not necessarily representative of those taking place at home.

target boy vs. girl in the study.

Fathers were 37.46 years old on average (SD: 6.75; Range: 24 – 58). Their socioeconomic profiles were mostly middle-class: 26.6% reported annual household income above $100,000 while more than half (64.3%) reported annual household income between $40,000 – $99,999. Half (51.4%) of the fathers completed a 4-year college degree or above while 40.3% attended some college or received an Associate's degree. Most fathers were married or partnered (88.3%) and they reported length of marriage with their current partner as 9.57 years on average (SD = 5.28; Range: 1 – 27). Most fathers were White (89.7%). The mean of number of children at home was 2.45 (SD: 1.00; Range: 1 – 6). About half of the families (53.8%) identified a boy (vs. a girl) as the target child in the study. Their children were 8.66 years old on average (SD = 2.74; Range: 4.06 – 13.61). Most fathers had been deployed 1-3 times (39.3%, 37.2%, 17.2%, for deployed once, twice, and three times, respectively). One third (35.2%) of the sample reported cumulative length of deployment as less than 12 months, another one third (31.7%) reported 13-24 months, 22.8% reported 25-36 months, and 10.3% reported more than 37 months.

Procedure

Recruitment. Families were eligible to participate in the RCT if at least one parent had been deployed to Afghanistan and/or Iraq since 2001 and at least one child was 4-12 years old. Participants were recruited using multiple strategies including presentations at events for National Guard/Reserves families, a targeted mailing from the local Veterans Affairs Medical Center, social media, flyers, and word of mouth.

Interested families completed an online survey to screen for eligibility and consent to participate. The current study analyzed data collected prior to the intervention and 1-year follow-up. All study procedures were approved by the University of Minnesota's Institutional Review Board.

Online survey. Participants received an online link to access the survey which included demographic information, deployment-related questions, and psychological measures.

In-home physiological data collection and family interaction tasks. Families were scheduled to complete an in-home assessment, administered by 2-3 trained technicians. Family members were guided to put on a Polar heart rate monitor (Model: RS800CX) for inter-beat intervals (IBIs) recording. Previously, researchers have validated this method for heart rate variability research (Nunan et al., 2009; Nunan et al., 2008; Quintana et al., 2012), suggesting that HF-HRV measures obtained with the Polar had no significant bias or additional random error in comparison with criterion measures (i.e. electrocardiography method) (Nunan et al., 2009)[9]. Researcher have used the Polar for psychophysiological research in adults (Fagundes et al., 2011). While wearing the Polar monitors, family members sat at a table and were instructed to complete a series of structured family interaction tasks. Fathers were seated throughout the tasks. Family interactions were video-taped.

Family members were presented with a list of family conflict issues that may

[9] But the authors noted that the conclusion may not be generalizable to data collected over longer periods (e.g., >10minutes).

cause conflicts between parents and the child (e.g., “making too much noise at home”), and rated the degree to which each issue had been a “hot topic” in the family in the past two weeks (0 = Irrelevant, 1 = Not at all “hot”, 2 = “Hot”, 3 = “Boiling hot”). The identified issues were utilized for conflict resolution. For deployment discussion tasks, family members selected a deployment-related issue that caused distress or conflict. The family interaction tasks used in the current study consisted of a reading task by father-(mother)-child[10]; conflict resolution tasks by father-child (and mother-child if applicable); a father-(mother)-child conflict resolution task; a father-(mother)-child toy play task; a father-mother conflict resolution task (if applicable); a father-(mother)-child puzzle task; deployment discussion tasks by father-child (and mother-child if applicable); a father-(mother)-child monitoring discussion task; and a father-(mother)-child fun activity planning task. Each task lasted 4-5 minutes. At the end, family members were instructed to take off their heart rate monitors and were debriefed. The order of the tasks was counter-balanced between fathers and mothers: specifically, half of fathers completed the father-child conflict resolution task immediately after the reading task, whereas the second half of the fathers completed a different task in between the reading and father-child conflict resolution tasks.

Physiological data processing. Videos of family interaction tasks were time-stamped in BORIS software (Friard et al., 2016) such that heart rate data could be tagged

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[10] In most of the cases, mother was also participating in the task, in which case the order of which parent read first was balanced. A small portion of the sample read a “Smiley bunny” story (n = 13) whereas most families read “Adelie penguin” and “American bullfrog” (n = 79). Independent sample t-tests were conducted, and no significant differences were detected. Thus, families who read the “Smiley bunny” story were also included in analyses.

by task. Inter-Beat Intervals (IBIs) data were processed in the RHRV program (Garcia, Otero, Vila, & Marquez, 2013). The program has the capability to process all data at once without individual data screening and processing. Because no validation study exists for the RHRV program, data from two family interaction tasks among the father sample were also processed in Kubios – a widely used software for HRV analysis (Tarvainen et al., 2014). The RSA values extracted from RHRV and Kubios were highly correlated (*r*s > 0.8), suggesting that RHRV is reliable and valid.

Measures

Demographic variables included father age, education, annual household income, marital status (0 = married; 1 = not married), child age/sex (0 = boy; 1 = girl), and number of children at home. Annual household income was categorized as 1 = less than $10,000; 2 = $10,000 – 19,999; … 15 = $140,000 – 149,999; and 16 = more than $150,000. Education was coded as 1= Some high school or less, 2 = GED, 3 = High school diploma, 4 = Some college, 5 = Associate's degree, 6 = Four-year college degree, 7 = Master's degree, and 8 = Doctoral or professional degree.

Times and length of deployment. Fathers reported the total times of deployments since 2001, as well as the cumulative length of being deployed. Length of deployments were answered on a scale of 0 – 7 (0 = no deployment in the current conflict; 1 = 6-months or less; 2 = 7~12 months; 3 = 13~18 months; … 6 = 31~36 months; and 7 = 37 months or more).

Assessment time. In-home assessments were conducted at different times in a day, which can affect HF-HRV measures (Laborde et al., 2017). The times of day when physiological assessment started were extracted from the Polar.

Medication status. Fathers were asked to indicate what medications they were using, and medication types/names were evaluated to determine their possible effects on vagal tone based on the literature and consultations with a pharmacist. Answers were categorized as: 0 = no effects or no medication use; 1 = low priority medication; and 2 = high priority medication (e.g., beta blockers). Fathers who had a value of 2 were excluded from the study (n = 2).

Alcohol use. The Alcohol Use Disorder Identification Test (AUDIT: Babor, Higgins-Biddle, Saunders, & Monteiro, 2001) was used to assess alcohol use problems because alcohol use problems may be a confounding variable of cardiac vagal tone. The scale has 10 items and a categorical variable was calculated (0 = no risk; 1 = low risk; 2 = risk; 3 = high risk). Only 4 individuals scored 2 and 3, thus a dummy variable was created with 0 indicating no risk and 1 indicating at-risk.

PTSD symptoms. The military version of the Posttraumatic Stress Disorder Checklist (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993) was used to assess posttraumatic symptoms related to military experiences. Respondents were asked to rate 17 items on a 5-point scale (1 = not at all; 5 = extremely), with each item indicating the severity of symptoms, for instance, “repeated, disturbing dreams of a stressful military experience”, “trouble falling or staying asleep,” and “feeling emotionally numb or being unable to have loving feelings for those close to you”. A composite score was created to indicate PTSD symptom severity. A dummy variable was also created to indicate PTSD status (i.e., scoring above the clinical cut off; 1 = PTSD; 0 = no PTSD). Clinical cutoff criteria were determined based on a symptom-clustering method consistent with DSM-IV (APA, 1994): if respondents endorsed one or more intrusion items, three or more avoidance items, and two or more hyperarousal items that were categorized at the moderate level, they were assigned a PTSD status (Hoge et al., 2004). In the current sample, 15.9% (n = 23) met these criteria.

HF-HRV during reading and during conflict resolution. Every 30-sec of the reading task and the father-child conflict resolution task, high frequency and low frequency absolute spectral powers (unit: ms^2) were calculated and subsequently a *normalized unit* was computed in each 30-sec window (HFn.u. = high frequency powers divided by the total of high frequency and low frequency powers; possible range: 0 to 100). A median of the repeated 30-sec HFn.u. values was taken to indicate HF-HRV during reading and HF-HRV during conflict resolution.

Vagal flexibility (VF). VF was computed as the HF-HRV difference between the two tasks (HRV reading – HRV conflict). Higher VF indicates greater vagal withdrawal (which can range between -100 to 100). A negative value of VF indicates that vagal control increased from reading to conflict resolution.

Observed parenting. Trained coders, who were blind to the intervention condition, scored all family interaction tasks with the exceptions of the reading task, using the Coder Impressions System (Forgatch, Knutson, & Mayne, 1992). Scores were obtained on the five factors – problem-solving, skill encouragement, monitoring, positive involvement and harsh discipline. Problem-solving assessed the quality of parent-child solving a problem, likelihood of the family putting the solution to use, and extent of resolution (9 items). Skill encouragement focused on parents' capacities to promote child skills through positive reinforcement and scaffolding (8 items). Monitoring evaluated parents' supervision and knowledge about the child's activities especially in situations when parents are not physically around (4 items). Positive involvement evaluated parental warmth, affection, sensitivity, and empathy toward the child (10 items). Harsh discipline concerned about parents' uses of overly strict, coercive, authoritarian, and inconsistent parenting strategies (8 items). Items for the first three factors were rated on a 5-point scale ranging from 1 (untrue) to 5 (very true). Items for the last two factors were rated on a 6-point scale ranging from 1 (never) to 6 (always).

Analyses

Data analyses followed several stages. First, we evaluated the measures of HF-HRV during reading and conflict resolution. We also examined the correlations between VF and other potential confounders. Second, descriptive statistics and intercorrelations were computed for key study variables. Third, a measurement model was estimated including two latent constructs: observed parenting at pre-intervention and at 1-year follow-up. Fourth, the intent-to-treat (ITT) intervention effect on parenting outcome was estimated in a structural model *without* including a moderator. Finally, VF was included as a moderator of intervention outcome in a structural model. Control variables included father education/income/marital status, length of deployment, PTSD status, child age/sex, and number of children at home.

Model fit indices were evaluated using recommended criteria (McDonald & Ho, 2002): a chi-square ratio (χ^2 /*df*) below 2.0, a comparative fit index (CFI) above .95, a standardized root mean square residual (SRMR) below .08, and a root-mean-square error of approximation (RMSEA) below .06. All structural equation modeling analyses were conducted in *M*plus 7.4.

Missing data

Baseline observed parenting had 4.8-6.2% missing values on all indicators except for monitoring (11%). This is perhaps because the monitoring task was one of the last family interaction tasks and some families skipped the task. Observed parenting at 1-year follow-up had 22.8-24.1% missing values on all indicators due to attrition. All demographic or deployment-related variables had less than 2% missing values. VF variable had complete data.

Independent samples *t*-tests showed significant differences between fathers who were missing baseline (n = 16) and those who were not (n = 128): fathers who missed baseline parenting data reported lower education, t (142) = 2.18, $p < .03$, younger child age, t (143) = 2.19, $p < .05$, and less length of deployment, t (143) = 2.28, $p < .05$. Only 16 individuals were missing baseline. To handle missing data, full information maximum likelihood (FIML) was used in *M*plus 7.4. FIML is an unbiased and efficient method for handling missing data (Enders & Bandalos, 2001).

Results

HF-HRV during reading and HF-HRV during conflict resolution were moderately correlated ($r = .43$, $p < .001$). HF-HRV significantly decreased from reading ($M = 26.75$, SD = 11.31) to conflict resolution (*M* = 32.00, SD = 15.34), t (144) = 4.33, $p < .001$, evidencing vagal suppression in the shift from reading to conflict resolution. Histogram of VF showed that it was normally distributed. VF did not significantly differ between those who completed the conflict resolution task subsequently after the reading task and those who had another task in between the two ($p > .05$). VF did not significantly differ between at-risk and no-risk groups with respect to alcohol use ($p > .05$). Neither did it differ between no medication use and medication use groups ($p > .05$). Home assessment time and VF were not correlated ($r = .10$, $p > .05$). While fathers with PTSD appeared to have lower VF (*M* = 2.31, SD = 15.70) than those without PTSD (*M* = 5.56, SD = 14.18), PTSD status did not significantly differentiate VF, t (142) = 0.99, $p > .05$. VF was negatively correlated with length of deployments ($r = -.20$, $p < .05$). There was a trend towards significance that VF was weakly correlated with PTSD symptoms ($r = -.15$, $p = .07$) and father age ($r = -.16$, $p = .06$).

The descriptive statistics of key variables are presented in Table 4, stratified by group assignment. No pre-existing differences were found between the intervention and control groups on key variables except that the control group’s skill encouragement was significantly better than the intervention group, t (135) = 2.36, $p < .05$. The intercorrelation coefficients among key variables are presented in Table 5.

A measurement model (Figure 4) was estimated prior to conducting a structural model. The measurement model included two latent constructs: parenting pre-intervention and parenting at 1-year follow-up. Each parenting construct had five indicators: positive involvement, problem-solving, harsh discipline, skill encouragement, and monitoring. The results showed acceptable fit to the data: χ^2 (29) = 36.21, *p* = .17, $\chi2$ /df <2.0, CFI = 0.98, RMSEA = .04, SRMR = .06.

To estimate the ITT intervention effect, parenting outcome at 1-year follow-up was predicted by group assignment (ADAPT = 1, control = 0), while controlling for parenting pre-intervention and demographic/deployment-related variables including education, marital status, income, child age/sex, number of children at home, length of deployment, and PTSD status. The model showed an acceptable fit, while the CFI was not optimal: $\chi2$ (109) = 132.18, *p* = .06, $\chi2$ /df = 1.21, CFI = 0.93, RMSEA = .04, SRMR = .06. Intervention condition did not significantly predict outcomes ($p > .05$), suggesting that there was no statistically significant intent-to-treat effect on post-deployed fathers' parenting at 1-year follow-up.

To test the moderation effect, a structural model including all covariates was estimated, in which parenting at 1-year follow-up was predicted by group assignment, mean-centered VF, and moderation (mean-centered VF multiplied by group assignment), while controlling for parenting pre-intervention, education, marital status, income, child age/sex, number of children at home, times and length of deployment, and PTSD status. The structural equation model showed an acceptable fit to the data: χ^2 (125) = 140.52, *p* = .16, χ^2 /*df* < 2, CFI = 0.95, RMSEA = .03, SRMR = .06. As a result, the intervention condition did not significantly predict parenting at 1-year follow-up ($p > .05$), neither did VF ($p > .05$). However, VF moderated the ITT effect on improved parenting at 1-year follow-up, B = 0.01, S.E. = 0.01, β = .37, *p* = < .05. None of the covariates were significantly associated with the parenting outcome except for marginally significant coefficients of child age (B = -0.02, S.E. 0.01, β = -.18, p = 0.09) and number of children (B = -0.067, S.E. = 0.036, β = -.182, p = 0.06). Finally, because education and income were moderately correlated (r = .43, p < .001), times and cumulative length of deployments were moderately correlated, the model was re-estimated without income and times of deployments. This final model demonstrated a good fit to the data: χ^2 (109) = 123.79, p = .16, χ^2 /df < 2, CFI = 0.95, RMSEA = .03, SRMR = .06. All factor loadings to the latent constructs were statistically significant (ps < .05). The results of the model are presented in Figure 5, showing significant moderation effect of VF by ITT on observed parenting at 1-year follow-up.

Plotting the region of significance (Figure 6) revealed that fathers with higher levels of VF had significantly greater improvements in observed parenting at 1-year follow-up if they were randomized into the ADAPT group, relative to those with lower levels of VF. About 23% of the current sample (145 fathers) fell into this region of significance for improved parenting. Their levels of vagal flexibility were approximately 0.78 SD above the sample mean. While fathers with very low VF showed significant decline in observed parenting at 1-year follow-up if they were randomized into the ADAPT group, only 3% (n = 4) of the sample fell into this region of significance. R-square for observed parenting at 1-year was estimated to be 0.436, suggesting that 43.6% of the variance were explained by the set of predictors in the model.

Discussion

This study is, to our knowledge, the first to report fathers' parasympathetic functioning as a predictor of their responsivity to a parent training program. Vagal flexibility (VF) is a physiological indicator of emotion regulation, psychological flexibility and social engagement behaviors (Porges, 1995, 2007) theoretically related to parenting (Crandall et al., 2015). We found that fathers' cardiac vagal tone decreased from reading to conflict resolution (which was manipulated as a stressful task), consistent with the literature (for a meta-analysis, see Shahrestani, Stewart, Quintana, Hickie, & Guastella, 2015). Fathers with higher vs. lower levels of VF showed significantly improved observed parenting if they were randomized into the ADAPT intervention. Thus, the interplay between a physiological marker (VF) and an environmental factor (the intervention) influenced the changes in post-deployed military fathers' parenting practices over one year.

Our study added to the existing data showing that that parental emotion regulation moderates intervention effects of the ADAPT on parenting. A number of such studies (e.g., Zhang, 2018; Zhang, Zhang, Gewirtz, & Piehler, 2018; Snyder et al., 2018) tested moderators and found that parents who self-reported *more* deficits in emotion regulation showed improved parenting in the ADAPT relative to those who reported less deficits. However, the parenting outcomes in these studies were primarily emotionally focused (e.g., positive engagement, distress avoidance, emotion socialization). Parents with more emotion regulation deficits may have more room for improvement in emotionally focused parenting, but this may not be generalizable to behavioral parenting. Because emotion regulation enables effective and consistent behavioral parenting (Snyder et al., 2013), emotion regulation deficits may inhibit post-deployed fathers from showing large improvements in the intervention with respect to behavioral parenting. Chesmore et al.,

(2017) found that fathers with PTSD – those who endorsed the most deficits in emotion regulation – showed negative changes in behaviorally focused parenting at 1-year follow-up in the ADAPT RCT. To address the personalization question further, the current study used a continuous variable as the moderator to elucidate more nuances concerning personalization while still controlling for PTSD status.

According to polyvagal theory, cardiac vagal tone generally serves the expression of motion, emotion, and communication by regulating the body's metabolism (changes in heart rate) and organs involved in vocalizations, which in turn contribute to individuals' approach or withdrawal behaviors in the environment (Porges, 2011, p. 140). Unlike self-reports that most likely capture *intrapersonal* emotion regulation or psychological flexibility, in this study, we measured VF when fathers and a child were physically proximal and interacting. Previously, we found that post-deployed fathers with high levels of VF did not exhibit significantly poor parenting even if they self-reported high levels of psychological flexibility (i.e., experiential avoidance) (MANUSCRIPT 1). In that case, VF may be associated with *interpersonal* emotion regulation, which contributed to positive changes in parenting as a result of a parenting intervention.

Given its unique role in healthy social interaction, high VF could also help fathers to strengthen or reestablish the relationships/emotional bonds with their family members including their children, regardless of their own experiences related to combat, and thus readily show improvements in parenting. Isgett et al. (2017) found that adults with higher vs. lower cardiac vagal tone were more likely to report being in a social environment with other people during typical everyday life. The authors suspected that high vagal activity may help the formation of relationships as individuals engage in social interactions. In another study, cardiac vagal tone was found to be negatively associated with hostile attribution bias during everyday lives (Okruszek, Dolan, Lawrence, & Cella, 2017). Moreover, when individuals were involved in social interactions and perceived low social support, high cardiac vagal tone buffered against rumination during the interaction (Gerteis & Schwerdtfeger, 2016). Finally, Muhtadie et al. (2015) found that VF was associated with psychological variables that are primarily social, and individuals with higher VF showed greater social sensitivity than their less flexible counterparts.

It is still unclear to what degree VF during social interactions is a useful indicator of PTSD. VF is correlated with but distinct from psychopathology. Our results suggested that PTSD symptoms were only weakly associated with VF, and PTSD status did not distinguish high or low levels of VF. However, a meta-analysis assessed HRV studies in the context of social interactions and found that individuals with psychopathology did not show as much flexibility of vagal suppression from a baseline to a stressful task, as did those without psychopathology (Shahrestani et al., 2015). Nonetheless, no studies included in this meta-analysis assessed PTSD. The fact that many studies on cardiac vagal tone and PTSD were conducted in non-social contexts makes it difficult to compare our findings against others.

It is important to note that baseline resting RSA was not measured in the current study. Vagal flexibility levels may be positively related to baseline RSA levels. Future research should test whether baseline (i.e., resting) RSA is a moderator of parents' responsivity to the ADAPT intervention. Bagner et al. (2012) found that baseline RSA was a moderator of treatment outcome for young children born premature with externalizing behaviors. Specifically, they reported evidence from a pilot RCT, showing that low levels of baseline RSA were associated with greater improvements in child disruptive behavior following the Parent-Child Interaction Therapy. It is not yet clear whether child RSA would also moderate child outcomes in the context of the ADAPT program. Eventually, evidence is needed to clarify the relationships between parental cardiac vagal tone, parenting behaviors, child cardiac vagal tone, and child outcomes in the context of interventions.

Several limitations and future directions should be considered. First, while we found significant results, the sample size was small and may have limited the observable range of VF and statistical power in structural equation modeling. Second, VF was operationally measured as vagal activity changes across two tasks that were differently manipulated. In contrast, most studies in the literature directly assessed baseline RSA using a resting task. Without baseline RSA, we were unable to conclude whether baseline RSA or vagal flexibility was the intervention moderator (or both). Third, the sample in the current study had all been exposed to combat trauma, and thus our findings may not be extrapolated to other family contexts or to mothers in post-deployed military families. Finally, future research in this field may consider assessing individual differences in cardiac vagal tone recovery after a stressful interaction task, as research suggested the important role of cardiac vagal tone in PTSD patients' recovery from arousal (Sack, Hopper, & Lamprecht, 2004).

Notwithstanding these limitations, the current study has important implications for the field of prevention-based interventions. By identifying a tailoring variable such as vagal flexibility, not only can a preventive intervention be individualized according to participants' characteristics, but it also can bring opportunities for adaptive research design (e.g., sequential multiple assignment randomized trials/SMART) to adjust the intervention according to participant responses over time (Ng & Weisz, 2016). Finally, because HRV is malleable, future researchers may consider incorporating HRV neurofeedback training into a parent training program designed for a parent population with elevated risk of PTSD (e.g., Wahbeh & Oken, 2013).

Conclusion

To meet the needs of different fathers and their families, vagal flexibility may be a tailoring variable informing the personalization of the After Deployment Adaptive Parenting Tools/ADAPT program and/or refinement with respect to dosage or components. Our initial findings contribute to the literature on precision-based prevention, but more evidence is needed before a conclusion is drawn regarding the relationship between parental vagal flexibility and parenting in fathers who are at risk for mental health problems such as PTSD.

Table 4. Descriptive statistics of key variables stratified by group assignment

Variable	Control Group				Intervention Group			
	Min	*Max*	*M*	*SD*	*Min*	*Max*	*M*	*SD*
Vagal flexibility	-31.14	40.31	5.70	15.42	-37.32	47.02	4.97	14.13
Positive involvement (BL)	2.31	4.50	3.45	0.48	2.25	4.41	3.38	0.52
Problem solving (BL)	1.27	3.66	2.52	0.61	1.39	3.81	2.57	0.61
Harsh discipline (BL)	1.00	2.88	1.33	0.36	1.00	2.88	1.35	0.40
Skill encouragement (BL)	1.44	4.81	2.88	0.70	1.31	4.13	2.59	0.69
Monitoring (BL)	2.00	4.75	3.26	0.76	1.00	5.00	3.17	0.95
Positive involvement (FU)	2.93	4.30	3.64	0.33	2.23	5.01	3.64	0.51
Problem solving (FU)	1.63	4.19	2.83	0.61	1.61	4.44	2.98	0.70
Harsh discipline (FU)	1.00	1.75	1.16	0.21	1.00	4.13	1.23	0.43
Skill encouragement (FU)	1.81	4.06	2.74	0.56	1.07	4.81	2.66	0.67
Monitoring (FU)	1.22	4.75	3.06	0.80	2.00	5.00	3.25	0.66

Note: BL = Baseline; FU = 1-year follow-up.

Table 5. Bivariate correlations among variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Child age	-	-.09	.24**	.07	-.06	.05	.06	.00	.02	-.23*	-.11	.03	-.28**	-.19*
2 Child sex	-.09	-	-.07	.00	.11	.13	.13	.16†	.00	-.02	-.07	-.11	.04	-.12
3 Number of children	.24**	-.07	-	.03	.16†	-.09	.12	.08	-.09	-.24*	-.19†	.08	-.14	.00
4 Income	.07	.00	.03	-	.25**	.42***	-.08	-.01	.09	.03	-.04	-.13	.07	.19†
5 Marital status	-.06	.11	.16†	.25**	-	.05	.04	-.09	.02	-.07	.06	-.02	.02	-.10
6 Education	.05	.13	-.09	.42***	.05	-	-.06	-.02	-.03	-.03	.00	.05	.01	.02
7 Deployment length	.06	.13	.12	-.08	.04	-.06	-	.06	-.20*	.02	.09	.06	.09	.19*
8 PTSD status	.00	.16	.08	-.01	-.09	-.02	.07	-	-.08	-.05	.02	.09	-.09	.02
9 VF	.02	.00	-.09	.09	-.02	-.03	-.20*	-.08	-	.16	.05	-.19*	.03	-.08
10 POSINV	-.22**	-.03	-.13	.13	-.06	.15†	-.13	.06	.12	.36**	.50***	-.37***	.49***	.19*
11 PROBSOLV	.00	.05	-.04	.09	.04	.10	-.07	.12	.04	.54***	.24*	-.19*	.31**	.11
12 Harsh Discipline	-.12	-.06	-.01	-.03	.19*	-.05	.04	-.10	.02	-.31***	-.31***	.37***	-.11	-.01
13 Encouragement	-.27**	.07	-.05	.15†	-.04	.16†	.06	.02	.07	.67***	.27**	-.13	.39***	.11
14 Monitoring	-.10	-.09	-.15†	.04	-.01	.06	.08	-.01	.07	.33***	.03	-.08	.39***	.30**

Note: Numbers below the diagonal show parenting indicators baseline, and numbers above the diagonal show parenting indicators 1-year follow-up. Numbers shown on the diagonal show correlations between same indicators across the two time points. POSINV = Positive involvement; PROBSOLV = Problem solving. † p<.10, * p<.05, ** p<.01, ***p<.001.

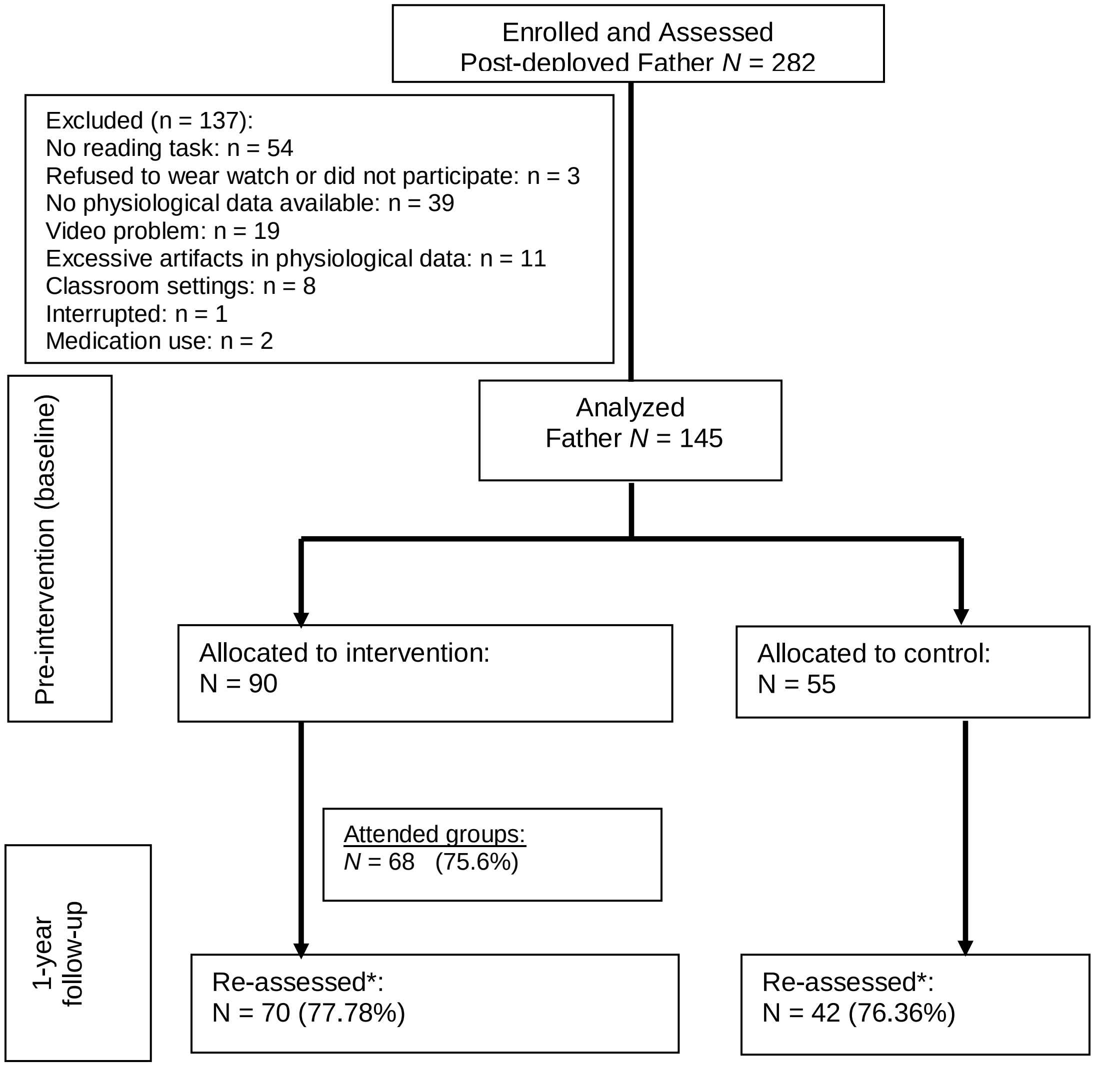

Figure 3. A CONSORT diagram of the current study.

Note: Numbers for fathers reassessed at 1-year follow-up refer to fathers who had data for the parenting measure used in this study.

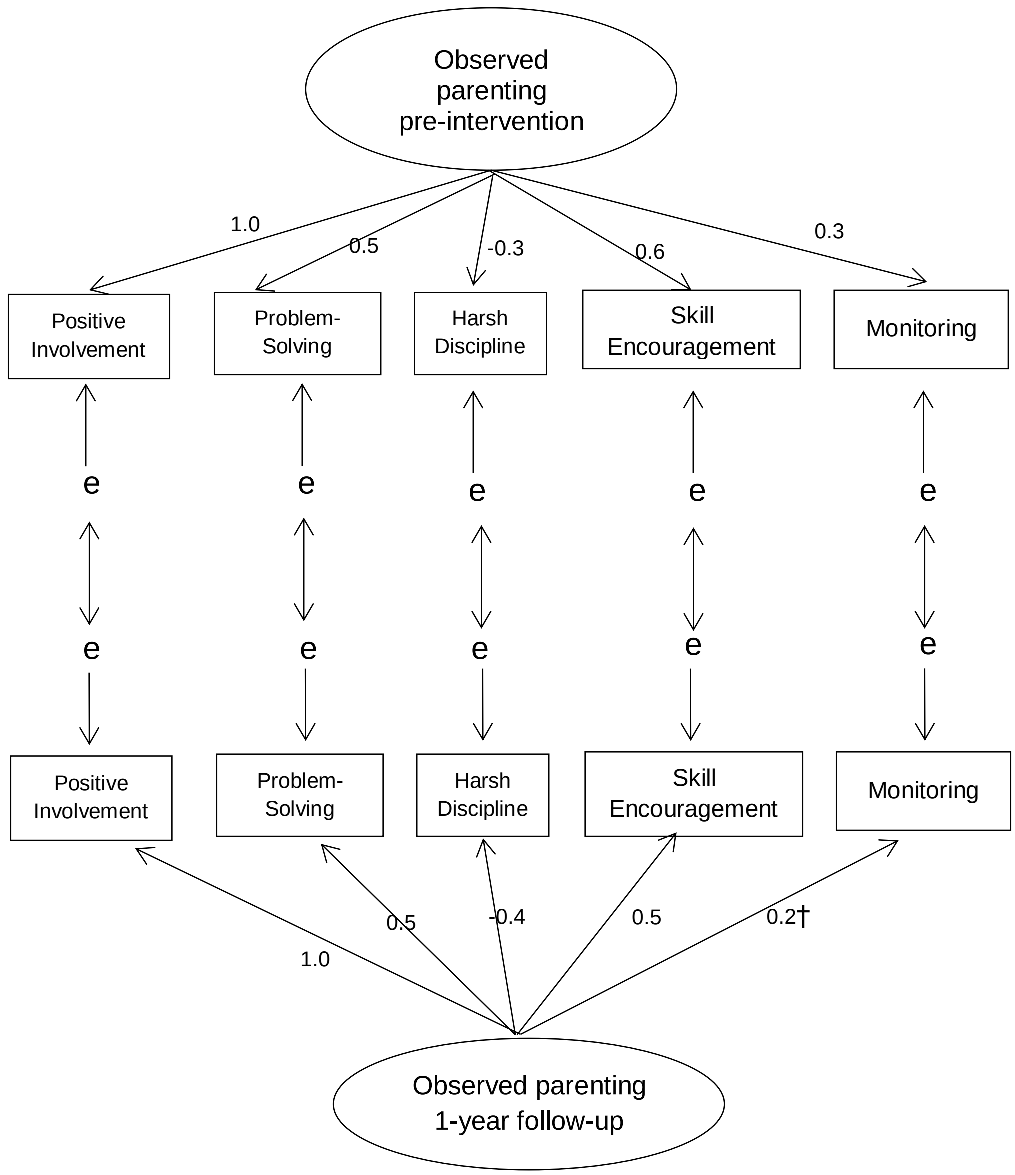

Figure 4. Factor loadings estimated in the measurement model.

Note: Model fit: χ^2 (29) = 36.207, p = .168, χ^2 /df < 2, CFI = 0.975, RMSEA = .042, SRMR = .062. Observed parenting pre-intervention and 1-year follow-up constructs were correlated in the model.

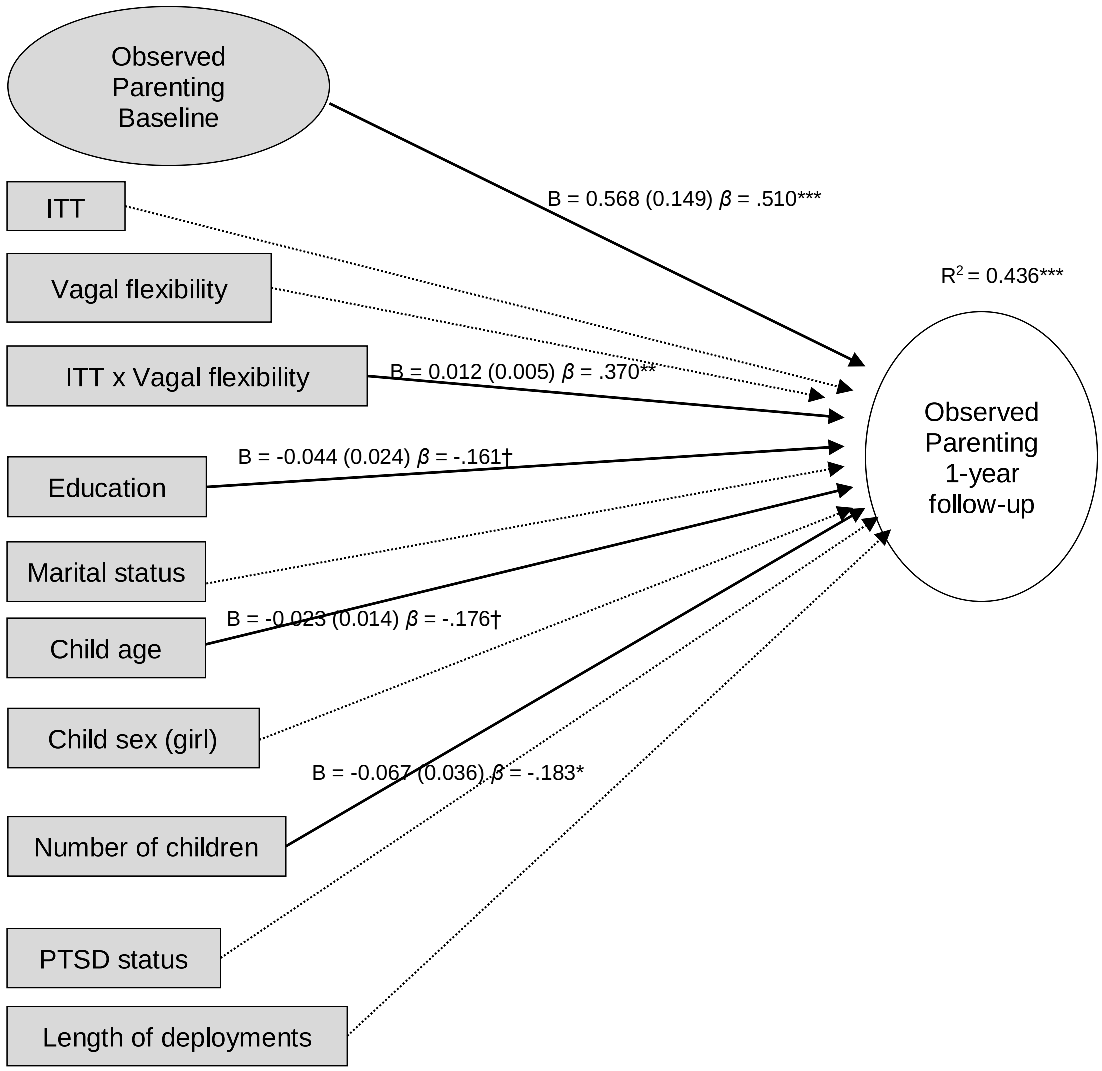

Figure 5. Estimated coefficients of the final moderation model. † *p*<.10, * *p*<.05, ** *p*<.01, ****p*<.001. Standard errors are shown in the parentheses. ITT = intent-to-treat intervention. Significant paths are shown as solid lines. Nonsignificant paths are shown as dotted lines. Model fit: χ^2 (109) = 123.785, *p* = .158, χ^2 /df < 2, CFI = 0.954, RMSEA = .031, SRMR = .058. All baseline control variables (shaded in grey) were specified to covary with each other.

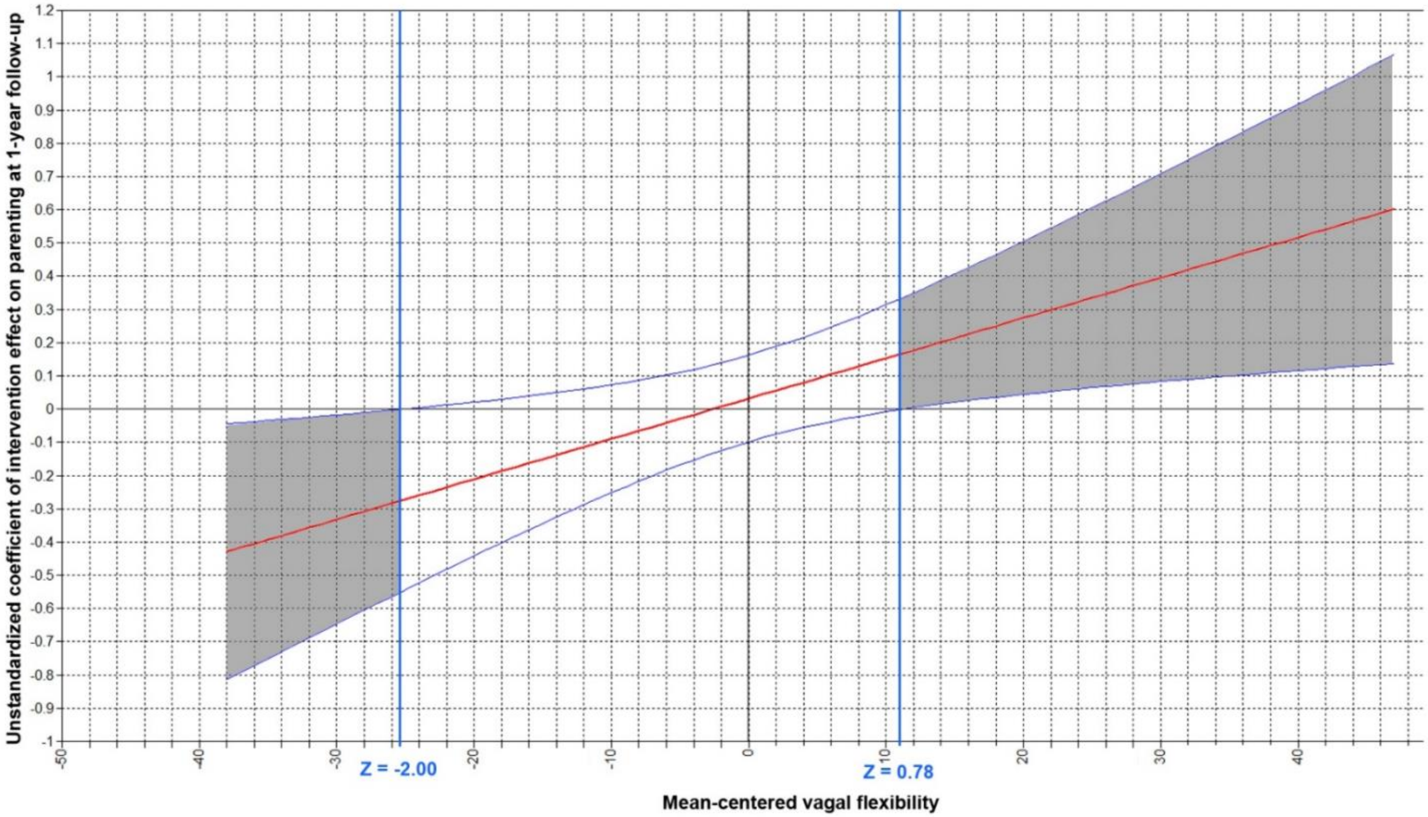

Figure 6. Vagal flexibility moderated intervention effect on observed parenting 1-year follow-up. X-axis indicates mean-centered vagal flexibility. The red line shows that unstandardized coefficients of the intervention effect on improved observed parenting at 1-year follow-up increases as fathers' vagal flexibility increases. The band indicates the 95% Confidence Interval. In the current sample, 22.76% are within the region of significance at the right end (shaded in grey), whereas only 2.76% are within the region of significance at the left end (shaded in grey).

COMPREHENSIVE DISCUSSION

Regarding cardiac vagal tone as a physiological indicator of emotion regulation and social engagement behaviors, the current research focused on military fathers who were affected by war deployments and investigated vagal flexibility in association with emotion-related parenting (Manuscript 1) and changes in parenting skills following a parent training program (Manuscript 2). Specifically, the first study demonstrated an interplay between vagal flexibility and self-reported psychological inflexibility in relation to parenting. High levels of vagal tone buffered the negative impacts of psychological inflexibility (i.e., experiential avoidance) on emotion-related parenting (i.e., positive engagement /withdrawal avoidance). Emotion-related parenting was observed using a macro-level coding system that focused on the basic dimensions of family interactions (positive vs. negative, approach vs. avoidance). One important future direction following this study is to test the associations between vagal flexibility, experiential avoidance, and emotion-related parenting longitudinally.

The second study utilized a prevention personalization approach, illustrating that vagal flexibility may be a variable that moderates fathers' responsiveness to a parent training program developed for post-deployed military families (ADAPT). The ADAPT program was based on Social Interaction Learning, with an emphasis on five dimensions of effective parenting skills: positive involvement, problem-solving, skill encouragement, monitoring, and discipline. These skills constitute theory-driven specific parenting behavior categories. The findings showed that fathers with higher vagal flexibility showed significant improved parenting skills in those categories in comparison with fathers with lower vagal flexibility if they were randomized into the intervention. Not only can these findings inform future directions for precision-based programming, but they also warrant further investigations into neurobiological factors to understand parenting behaviors of fathers from other family contexts. An important next step is to test whether cardiac vagal tone moderated mothers' responsivity in the ADAPT, as well as whether children's cardiac vagal tone moderated child outcomes in the ADAPT.

The two studies both measured fathers' parenting practices in a way that addresses the quality of fathers' parenting instead of the quantity (e.g., how much time a father spent with his child). Indeed, while fatherhood has been a relatively understudied research topic, the state of knowledge concerning the defining feature of fatherhood has shifted from an emphasis on moral guidance to economic provisioning, to sex-role modeling, and finally to *nurturance* (Lamb, 2000). In interacting with his child, a father who exhibits high positive engagement, low withdrawal avoidance, and effective parenting skills (involvement, problem-solving, encouragement, monitoring, and discipline) is a "nurturing" father. Biglan, Flay, Embry, and Sandler (2012) argued that nurturing family environments promote child wellbeing by: 1) minimizing biologically and psychologically toxic events; 2) teaching, promoting, and reinforcing prosocial behavior, including self-regulatory and other necessary skills for children to develop into productive adults; 3) monitoring and limiting problematic behaviors; and 4) fostering psychological flexibility. The findings from the two studies show that military fathers can be nurturing and can learn to be nurturing through parenting interventions.

Promoting positive and effective parenting in fathers has significant implications for post-deployed military families. As Paquette (2004) claimed, fathering is particularly important in domains such as facilitating children's openness, but a strong emotional bond is critical. In a military family where the father had been deployed, the father-child emotional bond may be disrupted by repeated and/or prolonged separations due to deployments, family members' elevated distress, or difficulties to reestablish family relationships during reintegration (Neelu Chawla & Solinas-Saunders, 2011; Gibbs, Martin, Kupper, & Johnson, 2007; Huebner, Mancini, Wilcox, Grass, & Grass, 2007). However, positive effective parenting can bolster father-child relationships. Not only is this critical for the child's development, but it also represents a protective factor for the father who had been exposed to combat trauma.

BIBLIOGRAPHY

Adamsons, K., & Johnson, S. K. (2013). An updated and expanded meta-analysis of nonresident fathering and child well-being. *Journal of Family Psychology, 27*, 589-599. doi:10.1037/a0033786

Aupperle, R. L., Melrose, A. J., Stein, M. B., & Paulus, M. P. (2012). Executive function and PTSD: disengaging from trauma. *Neuropharmacology, 62*, 686-694. doi:10.1016/j.neuropharm.2011.02.008

Bagner, D. M., Graziano, P. A., Jaccard, J., Sheinkopf, S. J., Vohr, B. R., & Lester, B. M. (2012). An initial investigation of baseline respiratory sinus arrhythmia as a moderator of treatment outcome for young children born premature with externalizing behavior problems. *Behavior Therapy, 43*, 652-665. doi:10.1016/j.beth.2011.12.002

Baker, D. G., Heppner, P., Afari, N., Nunnink, S., Kilmer, M., Simmons, A., . . . Bosse, B. (2009). Trauma exposure, branch of service, and physical injury in relation to mental health among U.S. veterans returning from Iraq and Afghanistan. *Military Medicine, 174*, 733-778. doi:10.7205/milmed-d-03-3808

Belsky, J., & Jaffee, S. R. (2015). The multiple determinants of parenting. In D. Cicchetti & D. J. Cohen (Eds.), *Developmental Psychopathology* (2nd Ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Belsky, J., & Pluess, M. (2009). Beyond diathesis stress: Differential susceptibility to environmental influences. *Psychological Bulletin, 135*, 885-908. doi:10.1037/a0017376

Biglan, A., Flay, B. R., Embry, D. D., & Sandler, I. N. (2012). The critical role of nurturing environments for promoting human well-being. *American Psychologist, 67*, 257-271. doi:10.1037/a0026796

Bonanno, G. A., Mancini, A. D., Horton, J. L., Powell, T. M., LeardMann, C. A., Boyko, E. J., . . . Smith, T. C. (2012). Trajectories of trauma symptoms and resilience in deployed US military service members: Prospective cohort study. *The British Journal of Psychiatry, 200*, 317-323. doi:10.1192/bjp.bp.111.096552

Brockman, C., Snyder, J., Gewirtz, A. H., Gird, S. R., Quattlebaum, J., Schmidt, N., . . . DeGarmo, D. (2016). Relationship of service members' deployment trauma, PTSD symptoms, and experiential avoidance to postdeployment family reengagement. *Journal of Family Psychology, 30*, 52-62. doi:10.1037/fam0000152

Butler, E. A., Wilhelm, F. H., & Gross, J. J. (2006). Respiratory sinus arrhythmia, emotion, and emotion regulation during social interaction. *Psychophysiology, 43*, 612-622. doi:10.1111/j.1469-8986.2006.00467.x

Cahill, S., & Foa, E. (2007). Psychological theories of PTSD. In M. J. Friedman, T. M. Keane, & P. A. Resick (Eds.), *Handbook of PTSD: science and practice* (pp. 55-77). New York, NY: The Guilford Press.

Campos, J. J., Walle, E. A., Dahl, A., & Main, A. (2011). Reconceptualizing emotion regulation. *Emotion Review, 3*, 26-35. doi:10.1177/1754073910380975

Card, N. A., Bosch, L., Casper, D. M., Wiggs, C. B., Hawkins, S. A., Schlomer, G. L., & Borden, L. M. (2011). A meta-analytic review of internalizing, externalizing, and academic adjustment among children of deployed military service members. *Journal of Family Psychology, 25*, 508-520. doi:10.1037/a0024395

Chalmers, J. A., Quintana, D. S., Abbott, M. J., & Kemp, A. H. (2014). Anxiety disorders are associated with reduced heart rate variability: A meta-analysis. *Frontiers in Psychiatry, 5*, 80. doi:10.3389/fpsyt.2014.00080

Chawla, N., & Ostafin, B. (2007). Experiential avoidance as a functional dimensional approach to psychopathology: An empirical review. *Journal of Clinical Psychology, 63*, 871-890. doi:10.1002/jclp.20400

Chawla, N., & Solinas-Saunders, M. (2011). Supporting military parent and child adjustment to deployments and separations with filial therapy. *The American Journal of Family Therapy, 39*, 179-192. doi:10.1080/01926187.2010.531647

Chesmore, A. A., Piehler, T. F., & Gewirtz, A. H. (2017). PTSD as a moderator of a parenting intervention for military families. *Journal of Family Psychology*. Advance online publication. doi:10.1037/fam0000366

Conger, R. D., Conger, K. J., Elder, G. H., Jr., Lorenz, F. O., Simons, R. L., & Whitbeck, L. B. (1992). A family process model of economic hardship and adjustment of early adolescent boys. *Child Development, 63*, 526-541. doi: 10.1111/j.1467-8624.1992.tb01644.x

Crandall, A., Deater-Deckard, K., & Riley, A. W. (2015). Maternal emotion and cognitive control capacities and parenting: A conceptual framework. *Developmental Review, 36*, 105-126. doi:10.1016/j.dr.2015.01.004

Deater-Deckard, K., Sewell, M. D., Petrill, S. A., & Thompson, L. A. (2010). Maternal working memory and reactive negativity in parenting. *Psychological Science, 21*, 75-79. doi:10.1177/0956797609354073

Deater-Deckard, K., Wang, Z., Chen, N., & Bell, M. A. (2012). Maternal executive function, harsh parenting, and child conduct problems. *Journal of Child Psychology and Psychiatry*, *53*, 1084-1091. doi:10.1111/j.1469-7610.2012.02582.x

Fagundes, C. P., Murray, D. M., Hwang, B. S., Gouin, J. P., Thayer, J. F., Sollers, J. J., 3rd, . . . Kiecolt-Glaser, J. K. (2011). Sympathetic and parasympathetic activity in cancer-related fatigue: more evidence for a physiological substrate in cancer survivors. *Psychoneuroendocrinology*, *36*, 1137-1147. doi:10.1016/j.psyneuen.2011.02.005

Flake, E. M., Davis, B. E., Johnson, P. L., & Middleton, L. S. (2009). The psychosocial effects of deployment on military children. *Journal of Developmental and Behavioral Pediatrics*, *30*, 271-278. doi:10.1097/DBP.0b013e3181aac6e4

Forgatch, M. S., & Gewirtz, A. H. (2017). The evolution of the Oregon Model of Parent Management Training: An intervention for antisocial behavior in children and adolescents. In J. R. Weisz & A. E. Kazdin (Eds.), *Evidence based psychotherapies for children and adolescents* (pp. 85-102). New York: Guilford Press.

Forgatch, M. S., & Patterson, G. R. (2010). Parent Management Training - Oregon Model: An intervention for antisocial behavior in children and adolescents. In J. R. Weisz & A. E. Kazdin (Eds.), *Evidence-based psychotherapies for children and adolescents* (pp. 159-178). New York, NY: Guilford.

Forgatch, M. S., Patterson, G. R., & Gewirtz, A. H. (2013). Looking forward: The promise of widespread implementation of parent training programs. *Perspectives on Psychological Science, 8*, 682-694. doi:10.1177/1745691613503478

Friard, O., Gamba, M., & Fitzjohn, R. (2016). BORIS: A free, versatile open-source event-logging software for video/audio coding and live observations. *Methods in Ecology and Evolution*, *7*, 1325-1330. doi:10.1111/2041-210x.12584

Fulton, J. J., Calhoun, P. S., Wagner, H. R., Schry, A. R., Hair, L. P., Feeling, N., . . . Beckham, J. C. (2015). The prevalence of posttraumatic stress disorder in Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) Veterans: A meta-analysis. *Journal of Anxiety Disorders*, *31*, 98-107. doi:https://doi.org/10.1016/j.janxdis.2015.02.003

Gardner, F., Hutchings, J., Bywater, T., & Whitaker, C. (2010). Who benefits and how does it work? Moderators and mediators of outcome in an effectiveness trial of a parenting intervention. *Journal of Clinical Child & Adolescent Psychology, 39*, 568-580. doi:10.1080/15374416.2010.486315

Gerteis, A. K. S., & Schwerdtfeger, A. R. (2016). When rumination counts: Perceived social support and heart rate variability in daily life. *Psychophysiology, 53*, 1034-1043. doi:10.1111/psyp.12652

Gewirtz, A. H., DeGarmo, D. S., & Zamir, O. (2016). Effects of a military parenting program on parental distress and suicidal ideation: After Deployment Adaptive Parenting Tools. *Suicide and Life-Threatening Behavior*, *46*, S23-31. doi:10.1111/sltb.12255

Gewirtz, A. H., DeGarmo, D. S., & Zamir, O. (2017a). After Deployment, Adaptive Parenting Tools: 1-year outcomes of an evidence-based parenting program for military families following deployment. *Prevention Science*. Advance online publication. doi:10.1007/s11121-017-0839-4

Gewirtz, A. H., DeGarmo, D. S., & Zamir, O. (2017b). Testing a military family stress model. *Family Process*. Advance online publication. doi:10.1111/famp.12282

Gewirtz, A., Pinna, K. L., Hanson, S. K., & Brockberg, D. (2014). Promoting parenting to support reintegrating military families: After Deployment, Adaptive Parenting Tools. *Psychological Services, 11*, 31-40. doi:10.1037/a0034134

Gewirtz, A., Polusny, M. A., DeGarmo, D. S., Khaylis, A., & Erbes, C. R. (2010). Posttraumatic stress symptoms among National Guard soldiers deployed to Iraq: Associations with parenting behaviors and couple adjustment. *Journal of Consulting and Clinical Psychology, 78*, 599-610. doi:10.1037/a0020571

Gewirtz, A., & Youssef, A. M. (2016). Parenting and children's resilience in military families: A twenty-first century perspective. In A. H. Gewirtz, A. M. Youssef, & S. M. Wadsworth (Eds.), *Parenting and children's resilience in military families* (pp. 1-9). Switzerland: Springer.

Gibbs, D. A., Martin, S. L., Kupper, L. L., & Johnson, R. E. (2007). Child maltreatment in enlisted soldiers' families during combat-related deployments. *JAMA, 298*, 528-535. doi:10.1001/jama.298.5.528

Gorman, G. H., Eide, M., & Hisle-Gorman, E. (2010). Wartime military deployment and increased pediatric mental and behavioral health complaints. *Pediatrics, 126*, 1058-1066. doi:10.1542/peds.2009-2856

Gross, J. J. (1988). The emerging field of emotion regulation: An integrative review. *Review of General Psychology, 2*, 271-299. doi: 10.1037/1089-2680.2.3.271

Hayes, S. C. (2016). Acceptance and commitment therapy, relational frame theory, and the third wave of behavioral and cognitive therapies (republished article). *Behavior Therapy, 47*, 869-885. doi:10.1016/j.beth.2016.11.006

Hayes, S. C., & Wilson, K. G. (1994). Acceptance and commitment therapy: Altering the verbal support for experiential avoidance. *The Behavior Analyst, 17*(2), 289-303.

Hoge, C. W., Auchterlonie, J. L., & Milliken, C. S. (2006). Mental health problems, use of mental health services, and attrition from military service after returning from deployment to iraq or afghanistan. *JAMA, 295*, 1023-1032. doi:10.1001/jama.295.9.1023

Huebner, A. J., Mancini, J. A., Wilcox, R. M., Grass, S. R., & Grass, G. A. (2007). Parental deployment and youth in military families: exploring uncertainty and ambiguous loss. *Family Relations, 56*, 112-122. doi:10.1111/j.1741-3729.2007.00445.x

Hughes, E. K., & Gullone, E. (2010). Parent emotion socialisation practices and their associations with personality and emotion regulation. *Personality and Individual Differences, 49*, 694-699. doi:10.1016/j.paid.2010.05.042

Isgett, S. F., Kok, B. E., Baczkowski, B. M., Algoe, S. B., Grewen, K. M., & Fredrickson, B. L. (2017). Influences of oxytocin and respiratory sinus arrhythmia on emotions and social behavior in daily life. *Emotion, 17*, 1156-1165. doi:10.1037/emo0000301

Johnson, A. M., Hawes, D. J., Eisenberg, N., Kohlhoff, J., & Dudeney, J. (2017). Emotion socialization and child conduct problems: A comprehensive review and meta-analysis. *Clinical Psychology Review, 54*, 65-80. doi:10.1016/j.cpr.2017.04.001

Kirby, J. N., Doty, J. R., Petrocchi, N., & Gilbert, P. (2017). The current and future role of heart rate variability for assessing and training compassion. *Frontiers in Public Health*. Advance online publication. doi:10.3389/fpubh.2017.00040

Laborde, S., Mosley, E., & Thayer, J. F. (2017). Heart rate variability and cardiac vagal tone in psychophysiological research – recommendations for experiment planning, data analysis, and data reporting. *Frontiers in Psychology*. Advance online publication. doi:10.3389/fpsyg.2017.00213

Lamb, M. E. (2000). The history of research on father involvement. *Marriage & Family Review, 29*, 23-42. doi:10.1300/J002v29n02_03

Lambert, J. E., Holzer, J., & Hasbun, A. (2014). Association between parents’ PTSD severity and children's psychological distress: A meta-analysis. *Journal of Traumatic Stress, 27*(1), 9-17. doi:10.1002/jts.21891

Leary, A., & Katz, L. F. (2004). Coparenting, family-level processes, and peer outcomes: the moderating role of vagal tone. *Development and Psychopathology, 16*(3), 593-608.

Lee, J.-k., & Schoppe-Sullivan, S. J. (2017). Resident fathers' positive engagement, family poverty, and change in child behavior problems. *Family Relations, 66*, 484-496. doi:10.1111/fare.12283

Lester, P., Aralis, H., Sinclair, M., Kiff, C., Lee, K. H., Mustillo, S., & Wadsworth, S. M. (2016). The impact of deployment on parental, family and child adjustment in military families. *Child Psychiatry and Human Development, 47*, 938-949. doi:10.1007/s10578-016-0624-9

Lester, P., Peterson, K., Reeves, J., Knauss, L., Glover, D., Mogil, C., . . . Beardslee, W. (2010). The long war and parental combat deployment: Effects on military children and at-home spouses. *Journal of the American Academy of Child and Adolescent Psychiatry, 49*, 310-320. doi: 10.1016/j.jaac.2010.01.003

Martínez, C. A. G., Quintana, A. O., Vila, X. A., Touriño, M. J. L., Rodríguez-Liñares, L., Presedo, J. M. R., & Penín, A. J. M. (2017). *Heart rate variability analysis with the R package RHRV*: Springer, Cham.

Mauss, I. B., Levenson, R. W., McCarter, L., Wilhelm, F. H., & Gross, J. J. (2005). The tie that binds? Coherence among emotion experience, behavior, and physiology. *Emotion, 5*, 175-190. doi:10.1037/1528-3542.5.2.175

Millegan, J., Engel, C., Liu, X., & Dinneen, M. (2013). Parental Iraq/Afghanistan deployment and child psychiatric hospitalization in the U.S. military. *General Hospital Psychiatry, 35*, 556-560. doi:10.1016/j.genhosppsych.2013.04.015

Milliken, C. S., Auchterlonie, J. L., & Hoge, C. W. (2007). Longitudinal assessment of mental health problems among active and reserve component soldiers returning from the iraq war. *JAMA, 298*, 2141-2148. doi:10.1001/jama.298.18.2141

Mills-Koonce, W. R., Propper, C., Gariepy, J. L., Barnett, M., Moore, G. A., Calkins, S., & Cox, M. J. (2009). Psychophysiological correlates of parenting behavior in mothers of young children. *Developmental Psychobiology, 51*, 650-661. doi:10.1002/dev.20400

Minassian, A., Geyer, M. A., Baker, D. G., Nievergelt, C. M., O'Connor, D. T., Risbrough, V. B., & Marine Resiliency Study, T. (2014). Heart rate variability characteristics in a large group of active-duty marines and relationship to posttraumatic stress. *Psychosomatic Medicine, 76*, 292-301. doi:10.1097/PSY.0000000000000056

Monn, A., Zhang, N., Gewirtz, A. H., & Snyder, J. (in press). Deficits in inhibitory control may place service members at risk for PTSD and impaired parenting behaviors following deployment-related trauma. *Journal of Traumatic Stress*.

Muhtadie, L., Koslov, K., Akinola, M., & Mendes, W. B. (2015). Vagal flexibility: A physiological predictor of social sensitivity. *Journal of Personality and Social Psychology, 109*, 106-120. doi:10.1037/pspp0000016

Ng, M. Y., & Weisz, J. R. (2016). Annual Research Review: Building a science of personalized intervention for youth mental health. *Journal of Child Psychology and Psychiatry, 57*, 216-236. doi:10.1111/jcpp.12470

Nunan, D., Donovan, G., Jakovljevic, D. G., Hodges, L. D., Sandercock, G. R., & Brodie, D. A. (2009). Validity and reliability of short-term heart-rate variability from the Polar S810. *Medicine and Science in Sports and Exercise, 41*, 243-250. doi:10.1249/MSS.0b013e318184a4b1

Nunan, D., Jakovljevic, D. G., Donovan, G., Hodges, L. D., Sandercock, G. R., & Brodie, D. A. (2008). Levels of agreement for RR intervals and short-term heart rate variability obtained from the Polar S810 and an alternative system. *European Journal of Applied Physiology, 103*, 529-537. doi:10.1007/s00421-008-0742-6

Ochsner, K. N., & Gross, J. J. (2005). The cognitive control of emotion. *Trends in Cognitive Sciences, 9*, 242-249. doi:10.1016/j.tics.2005.03.010

Okruszek, L., Dolan, K., Lawrence, M., & Cella, M. (2017). The beat of social cognition: Exploring the role of heart rate variability as marker of mentalizing abilities. *Social Neuroscience, 12*, 489-493. doi:10.1080/17470919.2016.1244113

Paquette, D. (2004). Theorizing the father-child relationship: Mechanisms and developmental outcomes. *Human Development, 47*, 193-219. doi: 10.1159/000078723

Perry, N. B., Calkins, S. D., Nelson, J. A., Leerkes, E. M., & Marcovitch, S. (2012). Mothers' responses to children's negative emotions and child emotion regulation: the moderating role of vagal flexibility. *Developmental Psychobiology, 54*, 503-513. doi:10.1002/dev.20608

Perry, N. B., Mackler, J. S., Calkins, S. D., & Keane, S. P. (2014). A transactional analysis of the relation between maternal sensitivity and child vagal regulation. *Developmental Psychology*, *50*, 784-793. doi:10.1037/a0033819

Park, N. (2011). Military children and families: strengths and challenges during peace and war. *American Psychologist*, *66*, 65-72. doi:10.1037/a0021249

Patterson, G. R., Forgatch, M. S., & Degarmo, D. S. (2010). Cascading effects following intervention. *Development and Psychopathology, 22*, 949-970. doi:10.1017/S0954579410000568

Piehler, T. F., Ausherbauer, K., Gewirtz, A. H., & Gliske, K. (2016). Improving child peer adjustment in military families through parent training: The mediational role of parental locus of control. *The Journal of Early Adolescence*. Advance online publication. doi:10.1177/0272431616678990

Porges, S. W. (1995). Cardiac vagal tone: a physiological index of stress. *Neuroscience and Biobehavioral Reviews, 19*(2), 225-233.

Porges, S. W. (2007). The polyvagal perspective. *Biological Psychology, 74,* 116-143. doi:10.1016/j.biopsycho.2006.06.009

Porges, S. W. (2011). *The polyvagal theory: Neurophysiological foundations of emotions, attachment, communication and self-regulation.* New York, NY: W. W. Norton & Company.

Pu, J., Schmeichel, B. J., & Demaree, H. A. (2010). Cardiac vagal control predicts spontaneous regulation of negative emotional expression and subsequent cognitive performance. *Biological Psychology*, *84*, 531-540. doi:https://doi.org/10.1016/j.biopsycho.2009.07.006

Pyne, J. M., Constans, J. I., Wiederhold, M. D., Gibson, D. P., Kimbrell, T., Kramer, T. L., . . . McCune, T. R. (2016). Heart rate variability: Pre-deployment predictor of post-deployment PTSD symptoms. *Biological psychology, 121*, 91-98. doi:10.1016/j.biopsycho.2016.10.008

Quintana, D. S., Heathers, J. A., & Kemp, A. H. (2012). On the validity of using the Polar RS800 heart rate monitor for heart rate variability research. *European Journal of Applied Physiology, 112*, 4179-4180. doi:10.1007/s00421-012-2453-2

Reddy, M. K., Meis, L. A., Erbes, C. R., Polusny, M. A., & Compton, J. S. (2011). Associations among experiential avoidance, couple adjustment, and interpersonal aggression in returning Iraqi war veterans and their partners. *Journal of Consulting and Clinical Psychology, 79*, 515-520. doi:10.1037/a0023929

Root, A. E., Hastings, P. D., & Rubin, K. H. (2016). The parenting behaviors of shy–anxious mothers: The moderating role of vagal tone. *Journal of Child and Family Studies, 25*, 1325-1333. doi:10.1007/s10826-015-0296-2

Rottenberg, J. (2007). Cardiac vagal control in depression: A critical analysis. *Biological Psychology, 74*, 200-211. doi:10.1016/j.biopsycho.2005.08.010

Rottenberg, J., Salomon, K., Gross, J. J., & Gotlib, I. H. (2005). Vagal withdrawal to a sad film predicts subsequent recovery from depression. *Psychophysiology, 42*, 277-281. doi:10.1111/j.1469-8986.2005.00289.x

Sack, M., Hopper, J. W., & Lamprecht, F. (2004). Low respiratory sinus arrhythmia and prolonged psychophysiological arousal in posttraumatic stress disorder: heart rate dynamics and individual differences in arousal regulation. *Biological Psychiatry, 55*, 284-290.

Sarkadi, A., Kristiansson, R., Oberklaid, F., & Bremberg, S. (2008). Fathers' involvement and children's developmental outcomes: a systematic review of longitudinal studies. *Acta Pædiatrica, 97*, 153-158. doi:10.1111/j.1651-2227.2007.00572.x

Shahrestani, S., Stewart, E. M., Quintana, D. S., Hickie, I. B., & Guastella, A. J. (2015). Heart rate variability during adolescent and adult social interactions: a meta-analysis. *Biological Psychology, 105*, 43-50. doi:10.1016/j.biopsycho.2014.12.012

Snyder, J., Low, S., Bullard, L., Schrepferman, L., Wachlarowicz, M., Marvin, C., & Reed, A. (2013). Effective parenting practices: Social interaction learning theory and the role of emotion coaching and mindfulness. In R. E. Larzelere, A. S. Morris, & A. W. Harrist (Eds.), *Authoritative parenting: Synthesizing nurturance and discipline for optimal child development*: American Psychological Association.

Snyder, J. (2014). *Macro-Level Family Interaction Coding System (MFICS)*. Technical Report. Wichita State University.

Snyder, J. (2015). Coercive Family Processes in the Development of Externalizing Behavior: Incorporating Neurobiology into Intervention Research. In T. P. Beauchaine & S. P. Hinshaw (Eds.), *The Oxford Handbook of Externalizing Spectrum Disorders* (pp. 286-302). New York, NY: Oxford University Press.

Snyder, J., Gewirtz, A. H., Schrepferman, L., Gird, S. R., Quattlebaum, J., Pauldine, M. R., . . . Hayes, C. (2016). Parent-child relationship quality and family transmission of parent posttraumatic stress disorder symptoms and child externalizing and internalizing symptoms following fathers' exposure to combat trauma. *Development and Psychopathology, 28*, 947-969. doi:10.1017/S095457941600064X

Snyder, J., Gewirtz, A. H., Zamir, O., Gird, S. R., Elish, K., Quattlebaum, J., . . . Pauldine, M. (2018). *Effects of the After Deployment Adaptive Parenting Tools intervention on distress avoidance and parenting behavior on male military service members deployed to Middle East conflicts.* Manuscript in preparation.

Stellar, J. E., Cohen, A., Oveis, C., & Keltner, D. (2015). Affective and physiological responses to the suffering of others: compassion and vagal activity. *Journal of Personality and Social Psychology, 108*, 572-585. doi:10.1037/pspi0000010

Tarvainen, M. P., Niskanen, J.-P., Lipponen, J. A., Ranta-aho, P. O., & Karjalainen, P. A. (2014). Kubios HRV – Heart rate variability analysis software. *Computer Methods and Programs in Biomedicine, 113*, 210-220. doi:https://doi.org/10.1016/j.cmpb.2013.07.024

Taylor, Z. E., Eisenberg, N., & Spinrad, T. L. (2015). Respiratory sinus arrhythmia, effortful control, and parenting as predictors of children’s sympathy across early childhood. *Developmental Psychology, 51*(1), 17-25. doi:10.1037/a0038189

Thayer, J. F., Ahs, F., Fredrikson, M., Sollers, J. J., 3rd, & Wager, T. D. (2012). A meta-analysis of heart rate variability and neuroimaging studies: implications for heart rate variability as a marker of stress and health. *Neuroscience and Biobehavioral Reviews, 36*, 747-756. doi:10.1016/j.neubiorev.2011.11.009

Tiwari, S., Podell, J. C., Martin, E. D., Mychailyszyn, M. P., Furr, J. M., & Kendall, P. C. (2008). Experiential avoidance in the parenting of anxious youth: Theory, research, and future directions. *Cognition and Emotion, 22*, 480-496. doi:10.1080/02699930801886599

Wadsworth, S. M., Bailey, K. M., & Coppola, E. C. (2017). U.S. Military Children and the Wartime Deployments of Family Members. *Child Development Perspectives, 11*, 23-28. doi:10.1111/cdep.12210

Wahbeh, H., & Oken, B. S. (2013). Peak high-frequency HRV and peak alpha frequency higher in PTSD. *Applied Psychophysiology and Biofeedback, 38*, 57-69. doi:10.1007/s10484-012-9208-z

Vasterling, J. J., Proctor, S. P., Friedman, M. J., Hoge, C. W., Heeren, T., King, L. A., & King, D. W. (2010). PTSD symptom increases in Iraq-deployed soldiers: Comparison with nondeployed soldiers and associations with baseline symptoms, deployment experiences, and postdeployment stress. *Journal of Traumatic Stress, 23*, 41-51. doi:10.1002/jts.20487

Williams, D. P., Cash, C., Rankin, C., Bernardi, A., Koenig, J., & Thayer, J. F. (2015). Resting heart rate variability predicts self-reported difficulties in emotion regulation: a focus on different facets of emotion regulation. *Frontiers in Psychology, 6*, 261. doi:10.3389/fpsyg.2015.00261

Wolgast, M., Lundh, L.-G., & Viborg, G. (2013). Experiential avoidance as an emotion regulatory function: An empirical analysis of experiential avoidance in relation to behavioral avoidance, cognitive reappraisal, and response suppression. *Cognitive Behaviour Therapy, 42*, 224-232. doi:10.1080/16506073.2013.773059

Zamir, O., Gewirtz, A. H., Labella, M., DeGarmo, D. S., & Snyder, J. (2017). Experiential avoidance, dyadic interaction and relationship quality in the lives of veterans and their partners. *Journal of Family Issues, 39*, 1191-1212. doi:10.1177/0192513X17698182

Zhang, J. (2018, May). More deficit, more benefit: Emotion regulation as a moderator of the effects of a military parenting program on effective parenting practices for male service members. Paper presented at the 26th Annual Meeting of the Society for Prevention Research, Washington D.C.

Zhang, N., Zhang, J., Gewirtz, A. H., Piehler, T. F. (2018). *Improving parental emotion socialization in military families.* Manuscript submitted for publication.